FROZEN FOOD
INDUSTRY

CARLTON

CARLTON

The Frozen Food Industry

By

HARRY CARLTON

University of Tennessee

Agricultural Experiment Station

1941

University of Tennessee Press

Knoxville, Tennessee

PREFACE

The survey of the frozen-food industry was made primarily in the interest of the important Tennessee production of strawberries and other fruits, and vegetables, to collect all possible information concerning the marketing of such products through this new industry, and to determine the probable effects of its future growth on Tennessee's markets for fresh and processed food products.

This report is an attempt to present a general picture of the procedures and methods employed by the frozen-fruit and -vegetable industry from the farm to the consumer, with special emphasis on markets and distribution. The field work covered a continuous period of approximately ten months, May, 1937, to March, 1938, during which time the important producing and packing areas and market centers were visited. Growers; packers of both frozen and canned goods; individuals engaged in the storage, transportation, and sale of frozen foods; and, wherever possible, retail and institutional consumers were interviewed.

The more important information covered by the University of Tennessee Agricultural Experiment Station Bulletin No. 161[1], "Frozen-Pack Fruit Markets," which was based on a survey of the northeastern markets for cold-pack fruits, has been incorporated in this report. Although the 1937-38 survey was mainly interested in the quick-frozen food industry, the major changes in the cold-pack fruit industry have been covered.

After completion of the field work a study was made of published material and reports on research, and short visits were made to the leading packing and marketing centers of the East in order to keep up to date the information on which this report is based.

Those interviewed were liberal with both time and information. Without their cooperation it would have been impossible to assemble reliable and informative data on which to base a report of this kind. Much of the information given was of a confidential nature and has been used only in its general application to the subject.

[1]Out of print.

CONTENTS

PART I

DISTRIBUTION

PART II

PRODUCTION FOR FREEZING

PART III

PROCESSING OPERATIONS

PART IV

The Frozen Food Industry

THE FROZEN FOOD INDUSTRY

PART I—DISTRIBUTION

EARLY HISTORY OF THE NEW FROZEN-FOOD INDUSTRY

The new frozen-food industry is based primarily on methods of freezing which preserve to the greatest possible extent the "freshness"—that is, the color, flavor, and texture—of the fresh products. It also delivers these "fresh" products to the consumer prepared for use and in sanitary packages. Combining the quality characteristics of fresh products with the convenience of canned, frozen food is in competition with both.

It is not proposed to go into the early history of the frozen-food industry except to trace briefly the inception of commercial freezing of fruits and vegetables so far as it affects the present status of the industry. In northern latitudes, freezing temperatures have been used for the preservation of fish, game, and other meats since before the memory of man—witness the popular story of the Siberian mastodon. But Nature does not use a thermostat or exercise year-round temperature control. Thaws come and the products spoil. Historical accounts of vast tribal migrations in search of food become understandable when we consider that the preservation of food by heat sterilization and storage in sealed containers was not commercially developed until the early part of the nineteenth century. Until that time the human race had to depend for preservation of their food supplies, on natural cold, drying in the sun or by fire, and various preservatives, such as salt, vinegar, and spices. The development of the art of canning has never received recognition commensurate with its contribution toward the survival and increase of populations and their wider distribution over the earth.

The next important advance in food preservation was made possible by the development of mechanical refrigeration, in the latter part of the nineteenth century. By controlling temperatures during transportation and storage, it was found that fruits and vegetables could be shipped from warm southern fields to cold northern cities without losing their fresh appearance and characteristics to a prohibitive extent. Meats, fish, poultry, eggs, could be chilled for short preserva-

tion periods or frozen and preserved from spoilage for indefinite periods. In the early days when the results were not always of the best, these products were popularly known as "cold-storage"—a name which later was avoided whenever possible. Whatever the early or present faults in its application, refrigeration has assisted immeasurably in the economical and convenient distribution of fresh foods, permitting a greater freedom to live in congested districts at greater distances from production areas, and still maintain a varied and healthful diet at reasonable cost.

Coincidentally with the development of canning and refrigeration—and made possible by advances in the knowledge and application of sanitary handling and the arts of processing and packaging—food production and preparation, as well as preservation and storage, have gradually been removed from the home to the factory. Consumers have become can and package addicts. This change did not occur without resistance from the older and more conservative elements, and criticisms of "lazy housewives" and neglected families "fed from tin cans and paper boxes." Nevertheless, the removal of labor from the kitchen to the factory has been as inevitable as civilization, and the popularity of prepared foods in convenient, sanitary packages is a fundamental factor in food distribution.

Preservation by heat results in a cooked product, in many cases an overcooked product, and consumers naturally prefer fresh fruits and vegetables, at least for variety and value in the diet. The demand for fresh products does not synchronize with the seasons, and this fact has encouraged the extensive and profitable early and out-of-season importation of food from our own southern states and from foreign countries with favorable growing seasons. These fresh foods are not prepared and packaged ready for use. All of which, in the natural course of events, set before the food industry the problem of providing prepared, fresh food in convenient sanitary packages, in season and out, at reasonable prices. Quick-frozen foods are the nearest thing to a solution of this problem that has been developed up to the present time.

Preservation of fruits and vegetables by freezing became practicable with the advances in the application of mechanical refrigeration. Experiments were made as early as 1860, using ice and salt as a freezing medium, but the development of the industry awaited the commercial exploitation of mechanical refrigeration to provide the necessary ranges and control of temperatures. Early experiments were not confined to any one locality or to any particular system or method of freezing, but were carried on in various parts of this country and Europe. Several freezing systems have survived and are now in commercial use.

Rapid freezing at low temperatures seems to have been early recognized as a fundamental principle in producing a good frozen product. Two general methods emerged in commercial freezing operations; the comparatively slow freezing used in "cold-packing" fruits and the "quick-freezing" methods applied to fruits, vegetables, meats, fish, and poultry.

"Cold-pack" is the somewhat inexact descriptive term originally applied to bulk-pack fruits which were frozen slowly and at comparatively high temperatures, usually 10° to 15° F.

"Quick-freezing" might be defined broadly as freezing at certain low temperatures by methods which carry the product through the crystal-forming stage in a minimum time. Authorities differ so widely as to the exact time and temperature, as well as methods of application, for obtaining the best frozen products, that a more exact definition is impossible.

COLD-PACK FRUITS

Freezing or cold-packing fruits for processors was developed into a standardized, established industry by the Northwest. The first substantial commercial pack, estimated at approximately 1,200,000 pounds, was made in 1918. Endowed with ideal soil and climatic conditions for growing fruits and vegetables, the Northwest by its isolation from the population centers of the Northeast, had been forced into processing its products for distribution. Naturally this section was interested in the early experiments in the preservation of fruits by freezing, not only because of the threat to their canning industry, but as a means of competing for the fresh-fruit markets in the Northeast.

Mr. H. S. Baker, Sr., is credited with making the first cold-pack experiments, in Denver, Colorado, in 1908. Three years later, in cooperation with local people at Puyallup, Washington, he produced and distributed a commercial pack of berries. In 1912, Baker started packing at Tampa, Florida; following the fruit season to Hammond, Louisiana; to Dayton, Tennessee; then to Norfolk, Virginia; and finally to Michigan. This routine was followed until 1917, when he confined his operations to the Northwest. Like many other northwestern pioneers in the industry, his company was still actively engaged in the business in 1935. It is interesting that Tampa, Hammond, and Norfolk today are among the important strawberry-packing centers in the eastern part of the country, and the industry is being revived in the Dayton, Tennessee, area.

Growers, packers, the U. S. Department of Agriculture, and Oregon and Washington State Colleges cooperated in developing better methods of packing and freezing to meet trade preferences, and the

Northwest's pack for processors became the standard by which cold-pack was judged in the markets of the Northeast.

Eastern cold-pack operations, with the exception of the red sour cherry pack, were unorganized and unrecorded. Considered by the eastern growers mainly as an outlet for fruit not salable in the fresh-fruit market, and usually treated as a more or less important side line by the packers, the eastern strawberry pack, in the opinion of a majority of the consumers interviewed in 1935, was not on a par with the northwestern pack. Naturally, the quality of the pack varied, depending on the standards of the individual packers, the variety and condition of the berries purchased, and the methods of freezing and handling. Even under these conditions, the East was packing at least 36 percent of the total frozen-fruit pack in 1935.

With increasing appreciation of the value of this market, and improved packing methods, growers and packers have raised the standards of the eastern pack until the greater part of the pack is now recognized as on a par with the northwestern. The exceptional suitability of the Tennessee Blakemore strawberry, especially for preserves and pies, is receiving recognition.

QUICK-FROZEN FRUITS AND VEGETABLES

Several early attempts made in the East to produce frozen fruits, particularly strawberries and peaches, and distribute them in small packages to the retail customer, met with failure of greater or less degree. The principal difficulty encountered was the lack of facilities for keeping the fruits frozen until they could be delivered to the consumer, rather than lack of demand or any reported dissatisfaction with the product if it could be kept frozen.

General Foods Corporation started their freezing experiments in New York State in the 1920's. They purchased the Clarence Birdseye quick-freezing patents and formed a subsidiary, Frosted Foods Sales Corporation, to develop and put on the market the Birds Eye line of frozen foods. The date of the first Birds Eye commercial pack is usually given as 1930. From the beginning its processing and distribution have been carried on in such complete independence of other packers that any discussion of the industry divides naturally under two headings—Birds Eye, and other packers and distributors. Retail distribution obstacles during these early years, as well as technical difficulties in freezing vegetables, discouraged small packers and distributors from seriously competing in the retail market, and they wisely confined their operations to processors' and institutional markets. The history of the introduction of quick-frozen foods to the retail trade, for the most part, is the story of Birds Eye's early operations.

EARLY DISTRIBUTION DIFFICULTIES

Distribution has been and still is the quick-frozen-food industry's most serious problem. As a sales proposition, preserved "fresh" fruits and vegetables, prepared and packaged ready for use and available the year round at moderate prices, seemed to be the perfect food product—a natural which would sell itself. Frozen-food pioneers saw visions of a consuming public demanding their products and of a coming revolution in the food-buying habits of the civilized world—the same kind of visions which had appeared to the inventors of the first "horseless carriages," while potential customers scoffed. Ahead of the automobile lay years of consumer education; and likewise the consumer had to be educated to demand and use frozen foods.

But of even more importance to the future of the automobile, were the rough, dusty roads which canceled the speed and comfort of the motor car. Frozen foods, likewise, found an established and intricate food-distribution system which had limited facilities for the transportation and storage of the new food. Quick-frozen foods not only had to be sold like any other new food product, but the industry faced the necessity of building new roads, or at least rebuilding old, to carry their distribution from the plant to the consumer.

When fruits and vegetables are quick-frozen and packaged for delivery to the hotel or the housewife, they are neither perishable fresh produce nor non-perishable canned products impervious to the ordinary hazards of distribution. Instead we have a new type of product, non-perishable at certain refrigeration temperatures, but extremely susceptible to even short exposures to normal temperatures, or the higher refrigeration temperatures most commonly used in food distribution. As the result of research and experience, 0° F. finally was accepted by the industry as "necessary for some products and harmful to none," as one authority put it; and the maintenance of this temperature with minimum fluctuations was recognized as important.

The existing food-distribution systems had been set up for foods which divided roughly into the following classes:

1. Packaged, non-perishable products, such as canned goods and cereals, which require no refrigeration for transportation and storage.

2. Fresh produce, which is refrigerated only if shipped long distances or held in storage for limited periods. Retail-store above-freezing refrigeration for this class was comparatively a new development and seldom available.

3. Meats, fish, poultry, which are either held above freezing for short periods or frozen solid for long storage and transportation. Usually allowed to thaw out in the retail store and sold as a fresh, unfrozen product. Ice refrigeration or slightly above-freezing me-

chanical refrigeration was the best that could be expected in retail stores selling these products.

4. The highly perishable dairy products, which require refrigeration at above-freezing temperatures during their distribution to the consumer.

5. Manufactured dairy products, such as butter and cheese; eggs and miscellaneous products which require refrigeration in transportation and storage.

6. Ice-cream products. This industry alone requires retail refrigeration facilities comparable to those demanded by the quick-frozen-food industry. Storage and transportation are limited, however, to short periods, and to local, conveniently reached territory. Low-temperature storage space is limited and long-distance transportation is seldom attempted.

Since no one of these food-distribution systems provided adequately for frozen foods, distribution had to move slowly, using existing facilities, as far as possible, and building up new ones.

Birds Eye started its institutional and retail distribution in the larger cities, where some low-temperature storage was available and consumer demand for high-quality fresh foods was considered greatest. The institutional trade proved receptive to this new food form, and in 1935 hotel and restaurant operators were using and expressing satisfaction with frozen fruits and vegetables. Distributors reported rapidly expanding sales. One Birds Eye distributor reported he had doubled his sales each year for the past 5 years and was optimistic of future expansion. Institutional distribution was not limited to Birds Eye products, but included frozen fruit from other sources, especially strawberries, red sour cherries, and red raspberries, and, in a few instances, frozen vegetables.

The lack of low-temperature transportation and storage facilities had not proved a serious drawback in the distribution of frozen fruits in the processors' markets. It was not difficult to adapt existing cold-storage warehouse space in the fruit-packing and marketing centers for the storage of bulk frozen fruits. In many localities sharp-freezer space was being used for frozen eggs and for frozen meats, fish, and poultry. The efficient, if limited, facilities of the ice-cream manufacturers enabled them to store stocks for their own use. The railroads provided refrigerated cars at around 15° to 20° F., which temperature apparently had no ill effects on the frozen fruits.

The 1935 survey found that the wholesalers and jobbers who had been distributing cold-pack fruits to processors were now delivering them, packed in smaller containers, to hotels and other institutional buyers, and keeping their daily delivery stocks in public warehouses.

In this way the Northwest fruit packers were able to start their penetration of the institutional trade markets. Packing fruit for the institutional trade presented no particular difficulties—the same general type of pack was used, put up in smaller containers. Distribution fell naturally into established channels: broker to wholesaler, or jobber, to consumer. Prices were logically higher for the smaller-unit packs, and the more widely distributed market lessened to some extent the competitive pressure on prices, which had developed in the established processors' market.

Improvements in freezing methods enabled packers to include quick-frozen vegetables in their lists of products for the institutional trade. Peas were most popular, followed by lima beans, sweet corn, and other vegetables. Experience proved, however, that vegetables were more susceptible to high or fluctuating storage temperatures, and the 10° to 15° F. which had proved adequate for the bulk, sugar-packed fruits, was too high for vegetables, especially over long storage periods.

Retail distribution difficulties were not as easily overcome. In their first retail sales operations, Birds Eye usually selected the largest independent retail grocers with the highest-class trade to handle the new food products. Since the grocer had no low-temperature storage facilities, he had to invest from $1200 to $2000 for a specially built refrigerated cabinet. No national, and practically no local, advertising was done, and his customers not only did not demand quick-frozen foods but probably had never heard of them. The retail grocer who had put in an expensive storage case found that its cost and maintenance amounted to a burdensome charge against his profits, and if he had fresh-fruit and vegetable and meat departments, he was competing with these departments. He saw no reason for spending time and money in advertising and developing consumer preference for this new food line which added materially to his expense but merely shifted sales from his original departments. This natural, if shortsighted, attitude of the retail grocer persisted after consumer acceptance became a self-evident fact, and has contributed to the trend toward marketing frozen foods through other retail outlets.

Retail distribution was practically in a state of collapse in the summer of 1935, except in New York, Boston, and the western New York cities of Rochester and Syracuse, where Birds Eye had tried out a new experimental sales policy. In other large cities in the Midwest and the Northeast, interviews with leading grocers, a few of whom had been induced to buy cabinets and attempt to sell the new food, found nothing but pessimism. Grocers had refused to take on the distribution, or were dissatisfied and had either abandoned the sale of frozen foods or relegated the expensive cabinet to a dark corner of the store. Nowhere throughout this section was there any evidence that the housewives knew anything about frozen foods—

either as to cost, proper handling and cooking, or nutritive value and identity with fresh foods rather than with canned or the old-fashioned "cold-storage" product.

The main features of the new sales and promotion policies which Birds Eye had put into effect in the fall of 1934, in Rochester and Syracuse, were:

1. Retail efforts were concentrated in the Northeast.

2. A less expensive mechanically refrigerated storage case was offered the retailer on a rental basis.

3. An established wholesale grocer was given exclusive distribution in each district.

4. A prominent food-advertising agency was given direction of the promotional advertising. Advertisements were directed to the housewife through her local daily paper.

When Rochester and Syracuse were visited a year later, in the fall of 1935, instead of the pessimism encountered in other cities, distributors, retailers and consumers all were enthusiastic over the new frozen foods. More than 100 retail installations were in operation in the Syracuse district, and retailers reported sales constantly increasing and customers repeating consistently.

In New York City—with a grocery store on nearly every corner in the residential districts, its crowded apartments with limited kitchen and storage space, and the many business women who pick up their supplies on their way home from work—there seemed no doubt, even in 1935, of consumer acceptance of quick-frozen foods.

Boston had pioneered with the pound cups of frozen fruits, which, as one grocer commented, "melted and became 'soup' on the counter." Sales of these cups had dropped to a nominal figure. A Boston grocer, however, reported three years of successful sales of Birds Eye products and satisfaction with quick-frozen foods.

Following out the new retail distribution policies, Birds Eye, by the end of 1935, had 1200 stores equipped with cabinets, mostly in New England and New York State. No other retail distribution, except the few attempts to retail frozen-fruit cups, was located in 1935. There were reports, however, that retail packs of both fruits and vegetables were being made in various parts of the country for 1936 distribution. These independent packers were faced with the same lack of retail storage facilities which had hampered the early Birds Eye retail sales attempts. Since Birds Eye owned the cabinets in the established retail outlets, and rented them for the exclusive storage of Birds Eye foods, other packers gained nothing by Birds Eye's promotion efforts, except by the local advertising and the education of the consumer to demand and properly use frozen foods.

GROWTH OF QUICK-FROZEN-FOOD DISTRIBUTION

The value of the advertising and other consumer education which had actually established retail distribution and consumer acceptance of quick-frozen foods in the Northeast was apparent when the 1937 survey was made. Chicago provided a striking example of the changes which had occurred. In the summer of 1935 the lone attempt at retail sales had been abandoned, not only because of lack of consumer demand, but because consumer unfamiliarity with the preparation and handling of the highly perishable product had resulted in endless trouble and complaints. But in the summer of 1937, more than 300 Birds Eye and Honor Brand retail outlets had been opened up, besides uncounted cabinet installations which were being served by local distributors. Housewives who apparently had never heard of quick-frozen food in 1935, or considered it "more cold-storage stuff," were heard discussing the "wonderful new food" in stores, restaurants, buses, and on the street.

Honor Brand, which as orginally organized was in effect a distributing agency for independent packers under the Honor Brand trade-mark, was in sharp competition with Birds Eye for the more desirable outlets, not only in Chicago, but in other large population centers. Other distributors had started operations under their own brands, or the packers' brands; some of them covering only local territory, others reaching out toward an ultimate national distribution system.

Everywhere, consumer demand was following closely the expanding popular knowledge of frozen foods. In Salt Lake City, the food department of the Zion Cooperative Mercantile Institution was retailing frozen foods from a 6-hole ice-cream cabinet. It reported being forced into the business by the demands of local residents who lived a part of the year in eastern cities, where they became familiar with frozen food, or who had visited the national parks, where these foods were served. The manager was enthusiastic over the quality of quick-frozen foods and the ease with which they could be sold, and was pushing them in competition with fresh products. Local food growers and processors were not unaware of this development and its threat to their fresh and canned production, and had called meetings to discuss the situation, with the evident determination of supplying their local markets with locally grown and processed frozen foods.

A Denver institutional distributor reported a sales volume in 1937 practically double that of 1936—between 5 and 6 cars. Frozen fish was one of the items showing increased sales. Denver business men also were watching the local sales. Insisting that they produced the best fruits and vegetables in the world, they saw no reason for importing the frozen products of other sections.

An Omaha retailer had started distribution in 1937 and reported excellent response, practically all trials resulting in steady customers. He also had been forced into the business by customers who had become familiar with frozen foods in the East.

Two retail markets in Minneapolis reported rapidly increasing interest by housewives, with at least half of the trial purchases resulting in regular customers. New customers showed greatest interest in the vegetables, later taking up fruits.

A food store in the Chicago "loop" was an exception. The manager pointed out that they were located in the heart of Chicago, a long distance from their customers' homes, and that in making deliveries their trucks were out from 8 to 10 hours, so that it would be impossible for them to handle frozen foods without expensive refrigerated-truck equipment. He believed retail outlets should be located in residential districts, where delivery distances would be short.

A Baltimore distributor, when interviewed in 1935, reported a distinct dip in sales during the local fresh-production season. This seasonal dip was not nearly so pronounced in 1937 and was becoming less each year.

One Florida retailer reported that he had been forced to handle frozen foods by the demands of winter visitors from the North, but that his sales to local all-year residents were consistently increasing. He carried a quite complete stock of the more popular fruits and vegetables, and although he was located within a few blocks of the fish wharves, where fresh fish were practically given away, he had a good trade in fillets of sole at 50 cents a pound and salmon steaks from the Northwest at 58 cents. This is a typical example of the sales appeal of a high-quality, ready-to-cook, packaged product. A similar condition was found in Charleston, where quick-frozen fish sales were mounting, apparently because of the lack of proper merchandising of the local fresh fish, and the appeal of good-quality, cleaned, nicely packaged frozen fish.

In the spring of 1938, hotels in Florida were serving frozen California orange juice, and strawberries and string beans from the North and Northwest. Fresh asparagus from California was competing with frozen asparagus from New Jersey, and Imperial Valley peas with "fresh" peas from Maine and New York.

The National Association of Retail Grocers held their first frozen-foods session during their convention in Cincinnati, June, 1938. This provided an excellent opportunity to observe the reactions of retail grocers to the new trends in food distribution which had been set in motion by frozen foods. They were concerned lest the action of ice-cream companies in taking up the distribution of frozen foods would lead to general food distribution by drugstores and ice-cream and con-

fectionery stores, in competition with grocery stores. At the same time there was evident a lack of enthusiasm for frozen foods on the part of many of the grocers present and a tendency to hold back from taking them on. The situation was picturesquely stated by a young grocer who warned them they would "wake up and find their baby in another man's cradle."

One of the exceptions to this general coolness to frozen food was a New England grocer who said he had been the third retailer in the country to take up the sale of frozen food. He was enthusiastic over frozen foods and had little patience with the criticisms which had been the general tenor of the meeting. He went so far as to say that he would be willing to handle frozen foods without any profit because of the business they attracted to his store, particularly the accounts of wealthy summer residents who knew and demanded frozen foods. He gave as an example a customer who came to him to buy $3.00 worth of frozen food but before leaving the store purchased $30.00 worth of other foods, and thereafter was a regular customer.

NEW DISTRIBUTION CHANNELS FOR FROZEN FOODS

The distribution of frozen foods is cutting across the established channels of food distribution and realigning the accepted order. The wholesale grocer, particularly if he has a large institutional trade, takes up frozen food to protect his canned-fruit and -vegetable sales. It also enables him to compete with fresh produce and to add fish, meat, and poultry departments. The fresh-produce distributor finds that frozen food is giving his fresh produce increasingly serious competition, and takes up its distribution as a protective measure. He also can add fish, meat, and poultry to his line without additional overhead. The meat and poultry distributor foresees competition from frozen products, and by taking on the distribution, adds "fresh" fruits and vegetables to his sales. A specific instance is the distributor of frozen fish and other seafoods in the Rocky Mountain area, who had his own cold-storage rooms and refrigerated trucks. By taking on frozen foods, he added fruits, vegetables, meats and poultry to his other lines.

Cold-storage warehouses interested in building up their low-temperature storage business have in some cases taken up both the packing and distribution of frozen foods.

All these channels are tending away from specialization and toward general food distribution. We can only speculate on the outcome. There may be fewer distributors, fewer salesmen calling on the trade, and fewer deliveries, when one distributor has a complete line to offer instead of a restricted class of foods.

THE ICE-CREAM MANUFACTURER IN FROZEN-FOOD DISTRIBUTION

Ice-cream manufacturers became actively engaged in the distribution of quick-frozen foods during 1937. They are well equipped by both experience and storage facilities for participation in the frozen-food industry. They are experienced in purchasing and processing agricultural products; in the quick automatic freezing of ice cream; in its storage at low temperatures in their hardening rooms; in distribution with low-temperature refrigerated trucks; and in merchandising through low-temperature cabinets to both the institutional and retail trades. Their facilities are operated at 0° F. and below and can easily be adapted to the distribution of frozen foods. They pack and distribute packaged goods. Figure 1 shows the national distibution of ice-cream hardening rooms available for frozen-food storage.

In the Southeast and other areas of low-density population, the local ice-cream hardening rooms often are the only available low-temperature storage. Packaged fruits, vegetables, meats, poultry, and fish may all be stored in hardening room, truck, and cabinet, together with

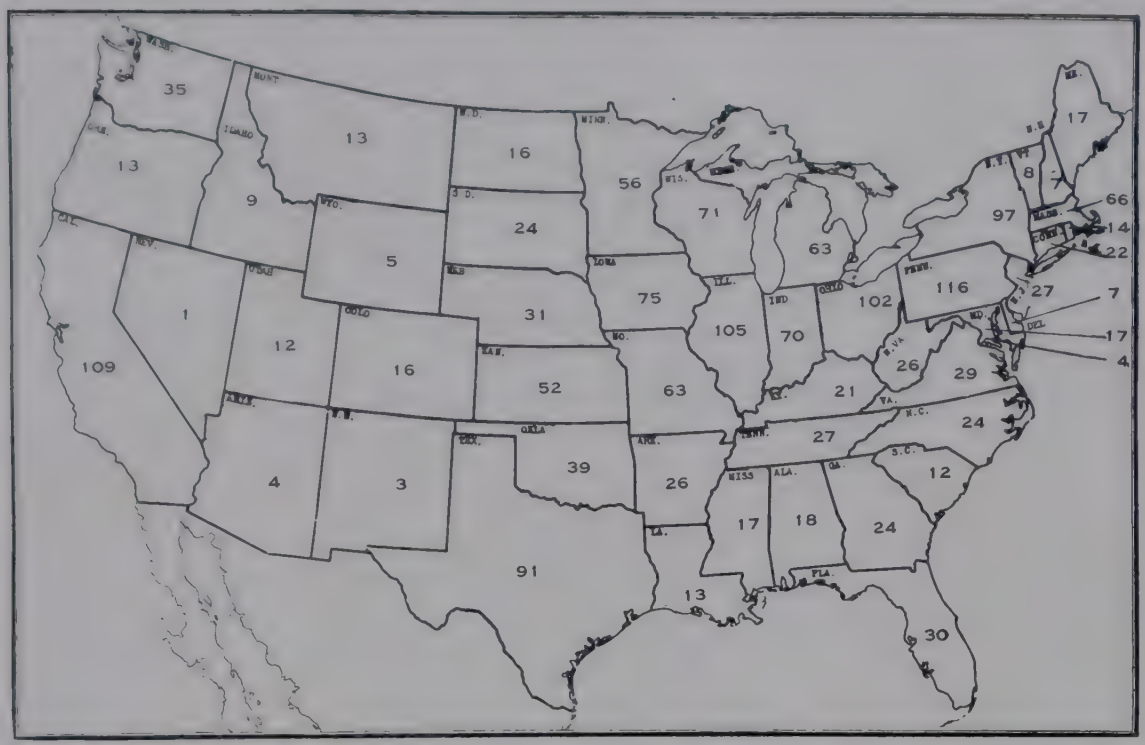

Fig. 1—Number and distribution of ice-cream hardening rooms available for frozen-food storage. Food Industries. Sept., 1938.

packaged and bulk ice cream. At the low temperatures used, even fish and ice cream, if properly packaged, can be stored together without contamination.

The president of one large ice-cream manufacturing company now distributing frozen food said that they added the new line because they had the necessary storage and trucking facilities, and in the ice-cream business, operations are greatly reduced from fall to early summer, when frozen-food sales are at a maximum.

Detroit is an example of a large city in which an ice-cream manufacturer is distributing quick-frozen foods to both the retail and institutional trades. The city is well supplied with low-temperature public cold-storage space suitable for storing frozen foods, and the decision to distribute through an ice-cream company cannot be attributed to a lack of other storage space, as might be the case in some of the outlying territories handled by ice-cream distributors.

In 1935, over 23 percent of all ice-cream sales were made through the manufacturer's own retail stores and by delivery direct to the home. Of all the many kinds of food manufactured, only one, bakery products, has a larger proportion of sales direct to the home. The trend toward the direct sale of ice cream is interesting in view of the ice-cream manufacturer's increasing importance in the distribution of frozen foods. If this trend continues, we may see large ice-cream organizations freezing products under their own brand and in effect becoming the single middleman in the processing and distribution of "fresh" products from farm to consumer.

WHY THE ACCEPTANCE OF QUICK-FROZEN FOODS IS INCREASING

Primarily, the increasing popularity of quick-frozen foods is due to the preservation of their harvest freshness, and the shifting of all kitchen work, except cooking and serving, from the kitchen to the factory—that is, to their quality and convenience. Although their economy is questioned on a strictly cost comparison with canned fruits and vegetables, or with fresh produce in season, users' testimony is not lacking that when the quality as compared to that of canned is taken into account, and the convenience and lack of waste as compared to fresh produce is considered, they are worth a reasonable additional cost.

The stability of the cost per portion, due to the small fluctuation in price, the uniform weight per carton, and the absence of waste, enables chefs, stewards, dieticians, and food-cost accountants to determine accurately their portion costs when using frozen foods over a 12-months period. This obviously is impossible when fresh produce is used.

One distributor summarizes the advantages of frozen food as follows:

1. Saves time in preparation of meals.
2. Saves labor—all items ready to cook and serve.
3. Saves space in refrigerator.
4. Vegetables cook in less than usual time.
5. Consumer buys completely edible portions, with no waste, pods, or stems, and no spoilage.
6. Wide variety the year round.
7. Uniformly high quality in all seasons.
8. Economical—showing real money savings.

When the industry has become established on a mass production basis and distribution broadened by better storage and transportation facilities, and the consumer has become more familiar with quick-frozen foods, their acceptance will undoubtedly be accelerated.

PRESENT EXTENT OF INSTITUTIONAL AND RETAIL DISTRIBUTION

By the early part of 1940, the quick-frozen-food industry had broadened its operations until distribution was in fact on a national basis. Distribution to the institutional trade was first to reach a national status, and retail distribution has followed as fast as production and facilities for storage and handling could be provided. From its beginnings in the densely populated areas, retail distribution has expanded gradually into the small cities and towns. Thinly spread out in most outlying sections, and with plenty of room in which to grow, retail sales will account for the greater part of the future growth of the industry.

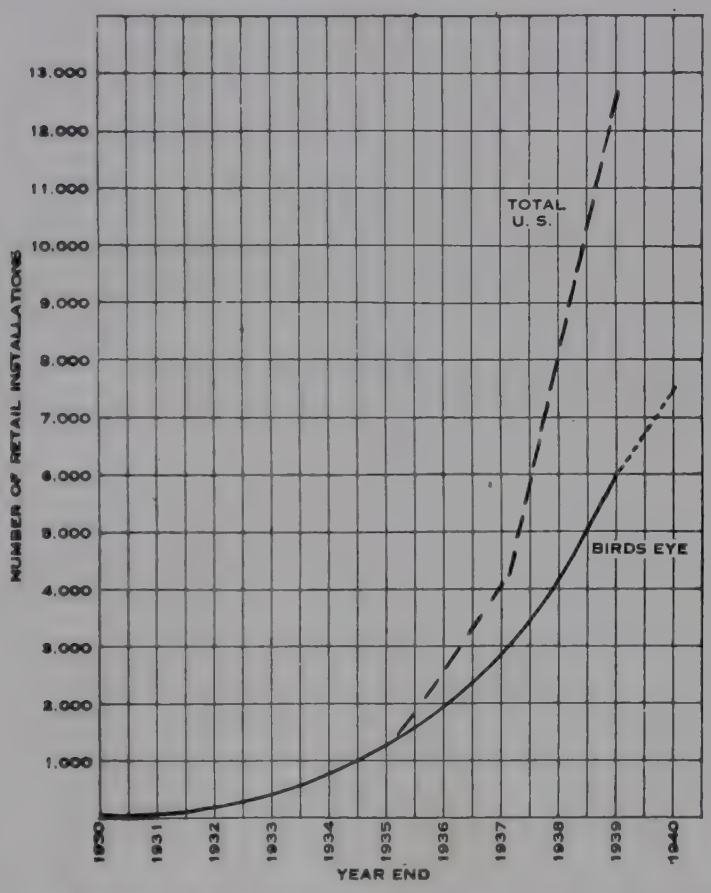

Fig. 2—Estimated growth of quick-frozen-food retail outlets.

Note.—Estimates for 1940 were low. Birds Eye has announced an unusual expansion in retail outlets in 1940, to a total of 10,000. The total number of installed retail cabinets probably reached 20,000 by January 1, 1941.

Figure 2 shows the estimated growth in number of retail stores selling quick-frozen foods since the business was started by the installation of 50 Birds Eye cabinets in 1930. These stores are equipped with low-temperature cabinets, built specifically for holding quick-frozen foods. No account is taken of the large but unknown number of retail outlets using ice-cream cabinets and other low-temperature facilities. These latter outlets obtain their stock in various ways,

many of them, by so-called "bootleg" operations, from the large distributors. That is, they buy retail packages from local institutional distributors who have no retail franchise, or in other "unauthorized" ways, probably without the knowledge of the national distributor of the brands purchased. One drugstore which bought frozen foods for its lunch counter kept its ice-cream cabinet so filled with frozen food there was scant room left for ice cream, and the ice-cream distributor suspected the packaged food was being sold to the drugstore patrons. A small grocery store in a seacoast city which had no established retail distribution, was selling frozen food which it purchased from other retail stores which were authorized outlets because they supplied the yachts lying in the harbor. It was unable to obtain sufficient supplies for its customers and was begging for a steady source of supply. Other retail outlets obtain a limited variety of items from local packers, which they supplement by purchases from institutional distributors of established brands.

The freezer-locker plant is an increasingly important factor in extending distribution to rural sections and to smaller cities where 0° F. storage would not otherwise be available. The plant operators buy frozen foods wholesale and sell in quantity to their renters for storage in their lockers, or put in a cabinet and retail to renters and the general public. In some localities freezer-locker plants are processing and freezing food products produced in the area under their own brand, which they distribute locally and in neighboring markets.

Taking into consideration the many "unauthorized" retail outlets, the independent local packing and distribution operations, and the freezer-locker plant, in addition to the "authorized" distribution operations, quick-frozen foods have become available in practically all sections of the country, if not always on a convenient or normal price basis.

FROZEN-FOOD PRODUCTION

Since the frozen-food industry has no national organization similar to the National Canners Association, or any other agency either public or private to which complete production reports are made, it is impossible to make any demonstrably accurate and informative estimates of the total production. The Northwest Frozen Foods Association reports, used by *Western Canner and Packer* in its Yearbook estimates, are segregated according to size and type of container and present an interesting record of the production of the packers belonging to the Association. The United States Department of Agriculture, Bureau of Agricultural Economics, in its monthly reports on cold-storage holdings, segregates frozen fruits by size of containers: small containers, less than 30-pounds capacity; and large containers, 30-pounds capacity or larger. No attempt is made to segregate meats, fish, and poultry frozen for storage and transportation, from the quick-frozen packaged food. These reports generally cover only the stock held in public warehouses.

Attempts to compile reliable figures by questionnaires sent to the individual packers have been hampered by duplicated production reports—the packer and the distributor of a private brand both reporting the same pack; by the refusal of the large packers to make their records public; and by the lack of definite accepted classifications and nomenclature for the various classes of frozen food.

CLASSIFICATION

From the commercial standpoint, frozen foods divide into three general classes:

1. Quick-frozen, or carton pack, for institutional and retail distribution.—Fruits, vegetables, meats, poultry, fish and other seafoods, prepared ready for cooking or serving, packaged at the factory, transported and stored at approximately 0° F., and delivered in frozen form in the original package, to the institutional or retail consumer.

2. Cold-pack, or frozen-bulk-pack, for processors.—Fruits frozen and packed in large containers (450-lb. barrels down to and including 30-lb. tins, boxes, lugs, and cartons) mainly for the preserve, ice-cream and pie industries.

3. Cold-storage, or frozen-storage.—Meats, poultry, and seafood which have been frozen for transportation and storage only, which are not necessarily prepared and packaged ready for use, and which are usually sold to the consumer thawed and as fresh products. While this classification is not commercially a part of the new frozen-food industry, an increasingly large proportion of this pack is being prepared and packaged ready for use, and is suitable for distribution under the first classification when distribution facilities are available.

These classes overlap to some extent in distribution and to an even greater degree with respect to the methods of freezing employed. Therefore, when production reports are segregated according to the method or speed of freezing, they do not conform to the above classification. For instance, all of the retail small-carton pack and the greater part of the institutional pack are presumably quick-frozen; but quick-freezing methods are employed also for substantial portions of the processors' and the frozen-storage packs. In fact, rapid freezing at low temperatures was first developed for the wholesale shipment and storage of fish.

FROZEN FRUIT AND VEGETABLE PRODUCTION, 1937

Tables 1 and 2, covering the 1937 fruit and vegetable packs, are based on reports received from the Northwest Frozen Foods Association, and *Western Canner and Packer,* and on the University of Tennessee Agricultural Experiment Station 1937-38 survey. The totals are made up from reliable pack reports and are believed to be conservative. No allowance was made for small unreported eastern packs or for the unreported production of some of the larger quick-frozen-food packers.

The vegetables covered in table 2 are all classed as quick-frozen and practically all packed in cartons. It is believed that this table is a fairly accurate estimate of the quick-frozen-vegetable production.

Frozen fruits, table 1, are classified, according to size of container and type of pack, as follows:

Bulk-pack—frozen-bulk-pack, or cold-pack, fruits in various-size containers, ranging from 450-pound barrels to 30-pound tins, inclusive. All unsegregated production reports known to be mainly cold-pack are included.

Small containers—under 30-pound-container packs. Reported carton or quick-frozen packs are included in this classification.

Single-frozen—This pack consists for the most part of cleaned berries frozen without sugar for the pie trade, packed mainly in 30-pound containers of various types; but some packers report their carton packs for the institutional and retail trade under this heading.

In distribution these divisions overlap. The larger packages in the small-container class may be used either by food processors or by the institutional trade. Single-frozen fruits are packed mainly for pie bakers, but are used also by other processors, and for institutional and retail distribution. Quick-frozen fruits for institutional and retail distribution were included in unsegregated production reports, which were incorporated in all of the three classifications.

TABLE I—*Frozen-fruits—U. S. produced and imported, 1937.*

Fruit	Oregon and Washington	California	Utah	Colorado	Michigan	Florida	Louisiana	Alabama	Tennessee	Virginia	Other eastern	Total U. S.
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Strawberries:												
Bulk pack	23,549,917		585,000		2,700,000	3,600,000	5,400,000	1,460,000	1,125,000	9,000,000	1,500,000	48,919,917
Small containers	3,017,689						300,000	100,000				3,417,689
Single-frozen	1,761,882											1,761,882
Juice	14,800											14,800
Total	28,344,288											54,114,288
Red raspberries:												
Bulk pack	7,145,898		60,000		1,200,000							8,405,898
Small containers	410,312											410,312
Single-frozen	768,680											768,680
Total	8,324,890											9,584,890
Red raspberry puree:												
Bulk pack	12,220											12,220
Small containers	3,063											3,063
Total	15,283											15,283
Loganberries:												
Bulk pack	1,528,184											1,528,184
Small containers	82.701											82,701
Single-frozen	758,755											758,755
Total	2,369,640											2,369,640
Blackberries:												
Bulk pack	5,195,320											5,195,320
Small containers	127,208											127,208
Single-frozen	1,111,302											1,111,302
Total	6,433,830											6,433,830
Black raspberries:												
Bulk pack	717,012				1,600,000							2,317,012
Small containers	81,814											81,814
Single-frozen	49,580											49,580
Total	848,406											2,448,406

TABLE I—*Frozen-fruits—U. S. produced and imported, 1937.—(Continued)*

Fruit	Oregon and Washington	California	Utah	Colorado	Michigan	Florida	Louisiana	Alabama	Tennessee	Virginia	Other eastern	Total U. S.
Youngberries:												
Bulk pack	157,466											157,466
Small containers	83,654											83,654
Single-frozen	166,481	[1]2,000,000										2,166,481
Total	407,601											2,407,601
Gooseberries:												
Bulk pack	24,260											24,260
Small containers	17,402											17,402
Single frozen	10,478											10,478
Total	52,140											52,140
Currants:												
Bulk pack	383,895											383,895
Small containers	15,922											15,922
Single-frozen	3,650											3,650
Total	403,467											403,467
Rhubarb:												
Bulk pack	78,676											78,676
Small containers	33,602											33,602
Single-frozen	166,404											166,404
Total	278,682											278,682
Grapes:												
Bulk pack	43,360											43,360
Total	43,360											43,360
Prunes:												
Bulk pack	237,400											237,400
Small containers	109,122											109,122
Single-frozen	42,125											42,125
Pulp—bulk pack	66,000											66,000
Total	454,647											454,647
Red sour cherries:												
Bulk pack[3]	2,944,340			900,000	6,000,000						24,000,000	33,844,340
Small containers	43,030											43,030
Total	2,987,370											33,887,370

Blueberries:												
Bulk pack	110,520											110,520
Small containers	1,325											1,325
Single-frozen	225,030											225,030
Total	336,875											336,875
Apricots:												
Bulk pack	25,120											25,120
Small containers	45,010											45,010
Single-frozen	74,037											74,037
Pulp		120,000										120,000
Total	144,167											264,167
Peaches:												
Bulk-pack	112,830										3,500,000[2]	3,612,830
Small containers	404,332											404,332
Single-frozen	286,245											286,245
Total	803,407											4,303,407
Boysenberries:												
Bulk pack	26,290											26,290
Small containers	1,101											1,101
Single-frozen	1,290											1,290
Total	28,681											28,681
Figs-in-sirup		20,000										20,000
Apple slices					1,950,000					3,250,000	1,300,000	6,500,000
Blueberries (imported)												8,947,416
Total	52,276,734	2,140,000	645,000	900,000	13,450,000	3,600,000	5,700,000	1,560,000	1,125,000	12,250,000	30,000,000	132,894,150

Definitions:

Bulk pack—Fruits packed in 30-lb. and larger containers, with or without sugar.
Small containers—Fruits packed in less than 30-lb. containers, with or without sugar—mostly institutional and retail trades.
Single-frozen—Fruits packed in boxes and cartons of about 30-lb., generally frozen before packing—mostly for pie trade.

[1]Includes unknown quantity of Boysenberries.

[2]Includes unknown quantity packed in small containers.

It is recognized that this is not an ideal classification; neither is it a complete coverage of the industry, nor even an approximate segregation of the production reported; but it is the best that could be done with the information available. What the grower, packer, distributor—everyone connected with the industry—needs to know is the production volume for the different markets; that is, processors', institutional, and retail. Type of pack and, more especially, size of container, are governed by the demand in these three markets.

Adding the small-container total, 4,897,000, to the single-frozen total, 7,425,000, makes 12,322,000 pounds—an obviously inadequate figure for the quick-frozen institutional and retail production alone; yet this total includes a substantial quantity of the pie and ice-cream pack, as well as all the reported production which could be identified as quick-frozen carton pack.

TABLE 2—*Quick-frozen vegetables—U. S. production, 1937.*

Vegetables	Oregon and Washington	California	Miscellaneous eastern	Total U. S.
	Pounds	Pounds	Pounds	Pounds
Peas	10,982,166	500,000	14,700,000	26,182,166
Green beans	1,810,054	----------	[1] 5,000,000	6,810,054
Cut corn	1,777,219	----------	2,289,436	4,066,655
Corn on cob[2]	305,910	----------	1,570,000	1,875,910
Wax beans	434,141	----------	----------	434,141
Lima beans	149,356	100,000	17,500,000	17,749,356
Asparagus	910,090	40,000	5,200,000	6,150,090
Spinach	792,659	----------	3,500,000	4,292,659
Broccoli	519,102	----------	1,500,000	2,019,102
Cauliflower	237,413	----------	----------	237,413
Carrots	81,703	----------	250,000	331,703
Peas and carrots	62,808	----------	100,000	162,808
Brussels sprouts	188,780	----------	----------	188,780
Squash	407,087	----------	----------	407,087
Total	18,658,488	640,000	51,609,436	70,907,924

[1]Includes wax beans in East.
[2]Corn on cob —6-inch ears of Golden Bantam average 4½ oz. each, or 3.375 lbs. per dozen.

According to information received from well-informed sources, the total 1937 quick-frozen carton food pack for institutional and retail distribution was—

	Pounds
Fruits	25,000,000
Vegetables	70,000,000
Seafoods	35,000,000
Poultry	10,000,000
Meats	5,000,000
Total	145,000,000

The vegetable total is in substantial agreement with table 2.

The startling discrepancy between the 12,322,000 single-frozen and small-container packs covered by table 1 and the estimated 25,000,000 quick-frozen fruits in the above estimate, may be explained by the fact that many eastern packers report their quick-frozen car-

ton pack with their bulk pack, and by the lack of production reports from many of the largest quick-frozen food packers. This brings up the question, how much of this 25,000,000-carton fruit pack is covered by the 133,000,000 total, and what part was never reported.

TABLE 3—*Comparison of* 1935 *and* 1937 *national frozen-fruit production.*

Fruit	1935	1937	Gain
	Pounds	Pounds	Pounds
Strawberries	42,910,000	54,114,000	11,204,000
Red sour cherries	16,000,000	33,887,000	17,887,000
Red raspberries	8,972,000	9,600,000	628,000
Blackberries	5,690,000	6,434,000	744,000
Loganberries	2,608,000	2,370,000	—238,000
Youngberries and Boysenberries		2,436,000	2,436,000
Black raspberries	1,107,000	2,448,000	1,341,000
Blueberries	5,100,000	9,284,000	4,184,000
Peaches	1,300,000	4,303,000	3,003,000
Apple slices	4,500,000	6,500,000	2,000,000
Miscellaneous	1,500,000	1,516,000	16,000
Total	89,687,000	132,892,000	43,205,000

The 1935 figures were based on the *Western Canner and Packer* 1936 Yearbook reports on the northwestern pack in 1935; Michigan Agricultural Experiment Station's report on the 1934 red sour cherry pack; and the 1935 market survey, including eastern-pack strawberries, peaches, frozen apple slices, and imported Canadian blueberries.

Turning to table 3, which is a comparative production report of the 1935 and 1937 frozen-fruit packs according to University of Tennessee surveys, it will be noted that the large increases are in the pie fruits—cherries, blueberries, apple slices, and the blackberry family; and in the three fruits, strawberries, red raspberries, and peaches, which are popular both in the institutional and retail trade and as pie fruits. It would be difficult to estimate how the increase in the three latter fruits should be divided between pies and the quick-frozen carton pack. Taking into consideration all the information we have available, however, we have arrived at 115,000,000 pounds as a conservative estimate for the frozen-bulk pack. Accepting the 25,000,000-pound carton-pack estimate as correct, this would indicate a total frozen-fruit pack of 140,000,000 pounds in 1937.

The 21,000,000-pound difference between this figure and the 119,000,000 pounds reported by *Western Canner and Packer* can be accounted for by their omission of the 9,000,000 blueberry importation, the 4,000,000 pounds of eastern apple slices, and other unreported packs located by the University of Tennessee 1937 survey and included in table 1 without taking into consideration the unreported quick-frozen carton packs which are not included in either report. A frozen-fruit pack of 140,000,000 pounds for 1937, therefore, appears to be a conservative estimate.

The 1935 survey was only incidentally concerned with the quick-frozen institutional and retail production, and little reliable information was available. From present sources of information a 2,000,000-

pound quick-frozen fruit pack and a 12,000,000-pound vegetable pack, in 1935, would be a reasonable estimate.

ESTIMATED QUICK-FROZEN-FOOD PRODUCTION, 1938

From the same well-informed sources which provided the data on which the estimated 145,000,000-pound 1937 pack of quick-frozen foods was based, information has been received on the 1938 pack, which totals as follows:

	Pounds
Fruits and vegetables	190,000,000
Seafoods	45,000,000
Poultry	10,000,000
Meats	5,000,000
Total	250,000,000

Compared with the 1937 estimate, the frozen-fish pack was increased by 10,000,000 pounds, and the combined quick-frozen fruit and vegetable pack was doubled in 1938. The opinion was expressed that vegetables accounted for practically all of the increase, which would indicate a vegetable pack of around 150,000,000 pounds. This is not in agreement with other reports, which indicated only a moderate increase over the 1937 pack, but is somewhat in line with the increase in cold-storage-holding reports of the Department of Agriculture (figure 3), so far as their coverage of quick-frozen vegetables is concerned. These reports showed peak holdings in 1937 of about 32,000,000 pounds, which increased to 71,000,000 pounds, or more than double, in 1938.

ESTIMATED QUICK-FROZEN-FOOD PRODUCTION, 1939

Preliminary estimates have been received indicating that the quick-frozen-food pack in 1939 was—

	Pounds
Fruits and vegetables	290,000,000
Seafoods	45,000,000
Poultry	10,000,000
Meats	5,000,000
Total	350,000,000

COLD-STORAGE HOLDINGS

The monthly reports of cold-storage holdings, made by the United States Department of Agriculture, Bureau of Agricultural Economics, are the only public records of the ebb and flow of frozen-fruit and vegetable stocks. These reports do not give the actual total stocks on hand at any particular time, but represent an unknown and probably varying percentage of the total. Many distributors and packers who are known to be large holders of quick-frozen fruits and vegetables hold their stocks in private warehouses and make no reports to

the Bureau. No reports are made of the active trading stocks held in ice-cream hardening rooms and other temporary holding rooms.

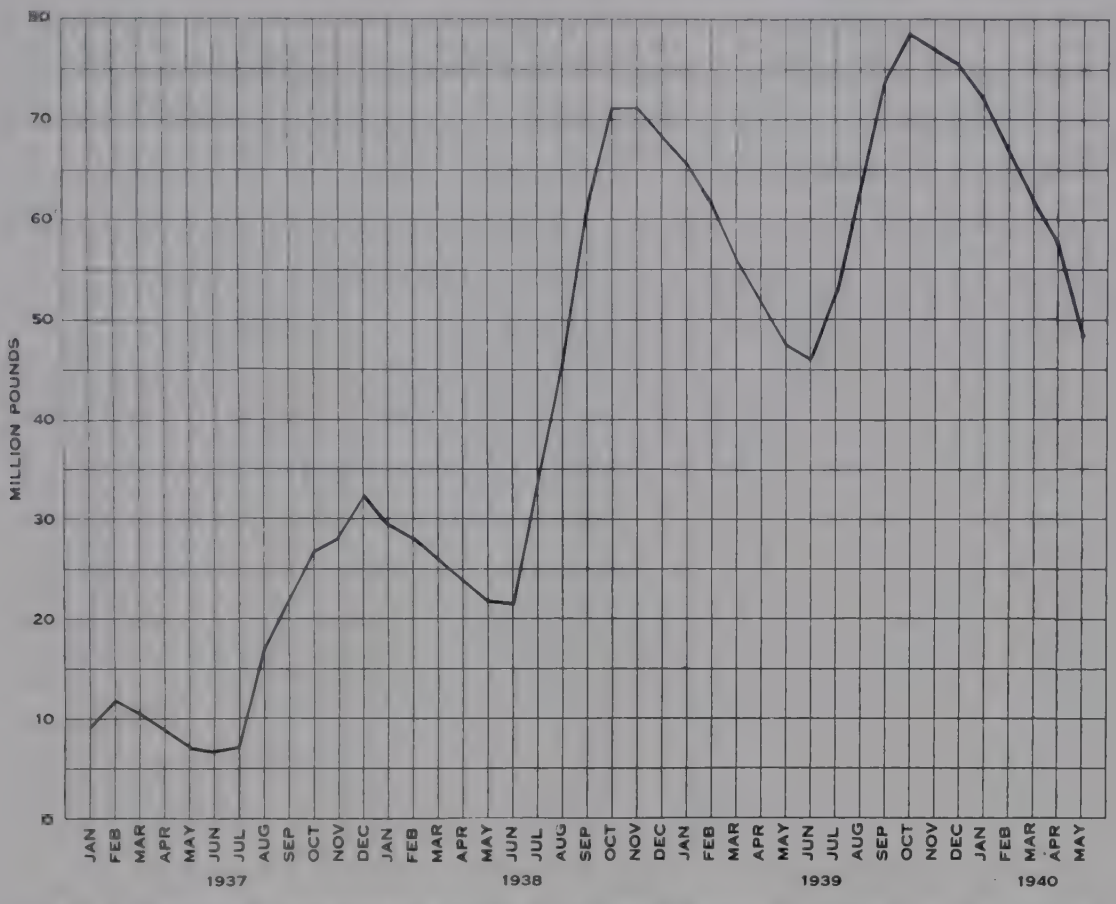

Fig. 3—Reported cold-storage holdings of quick-frozen vegetables in the United States. U. S. Dept. of Agr.

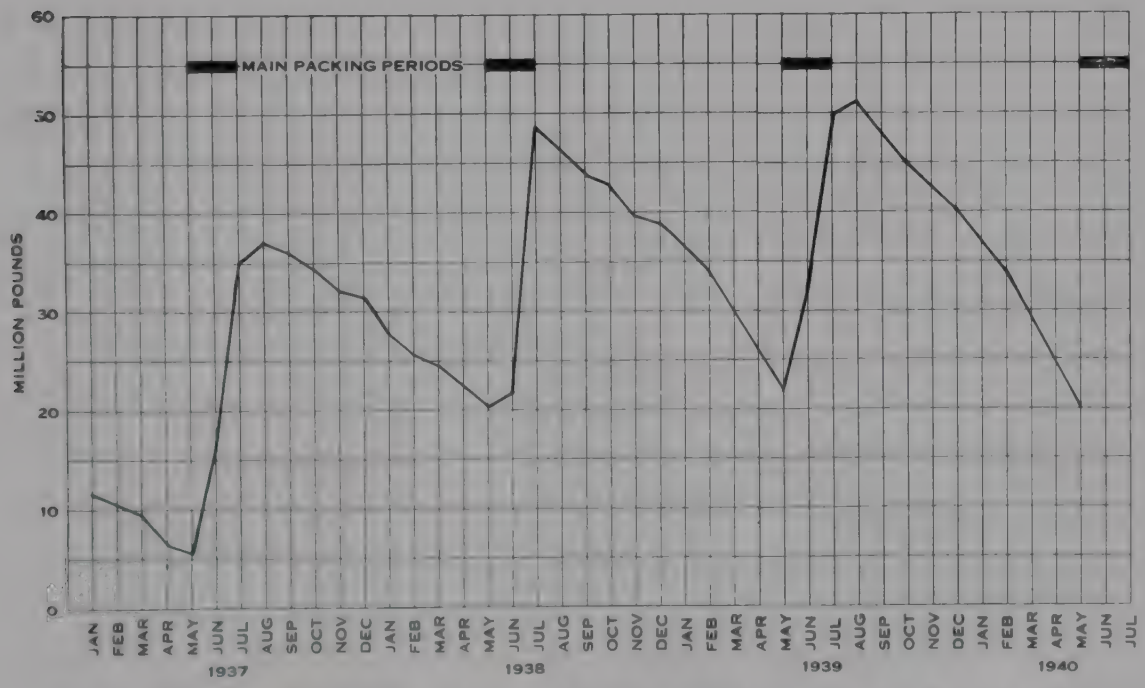

Fig. 4—Reported cold-storage holdings of frozen strawberries in the United States. U. S. Dept. of Agr.

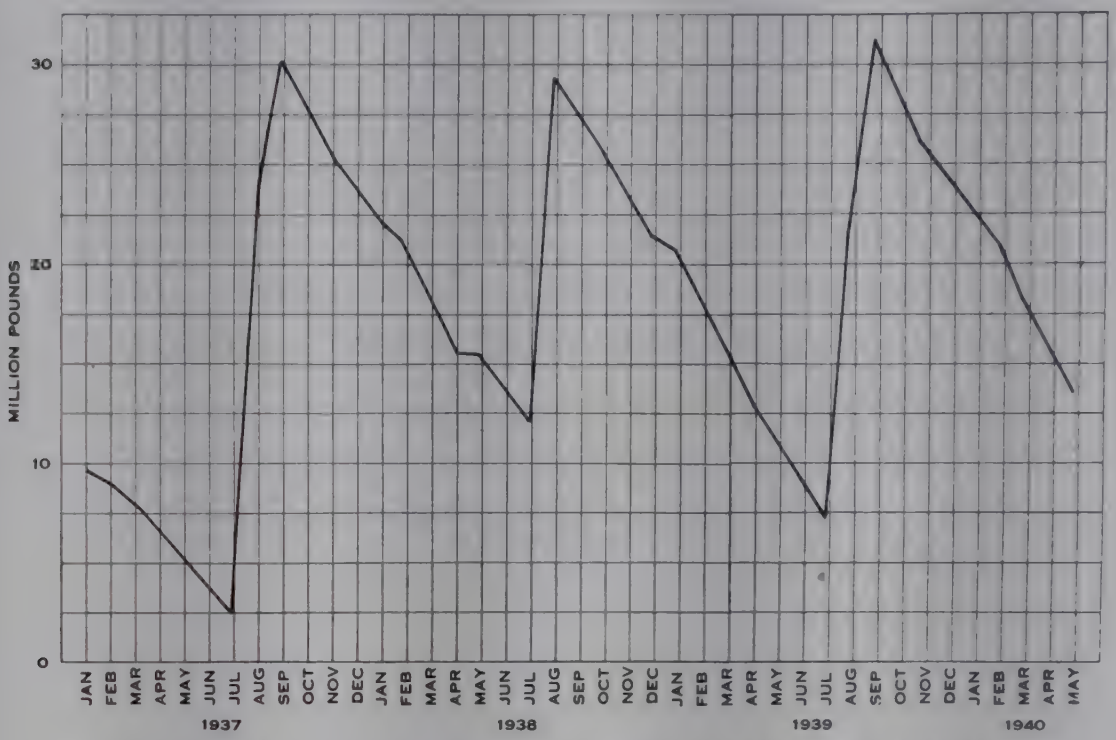

Fig. 5—Reported cold-storage holdings of frozen cherries in the United States. U. S. Dept. of Agr.

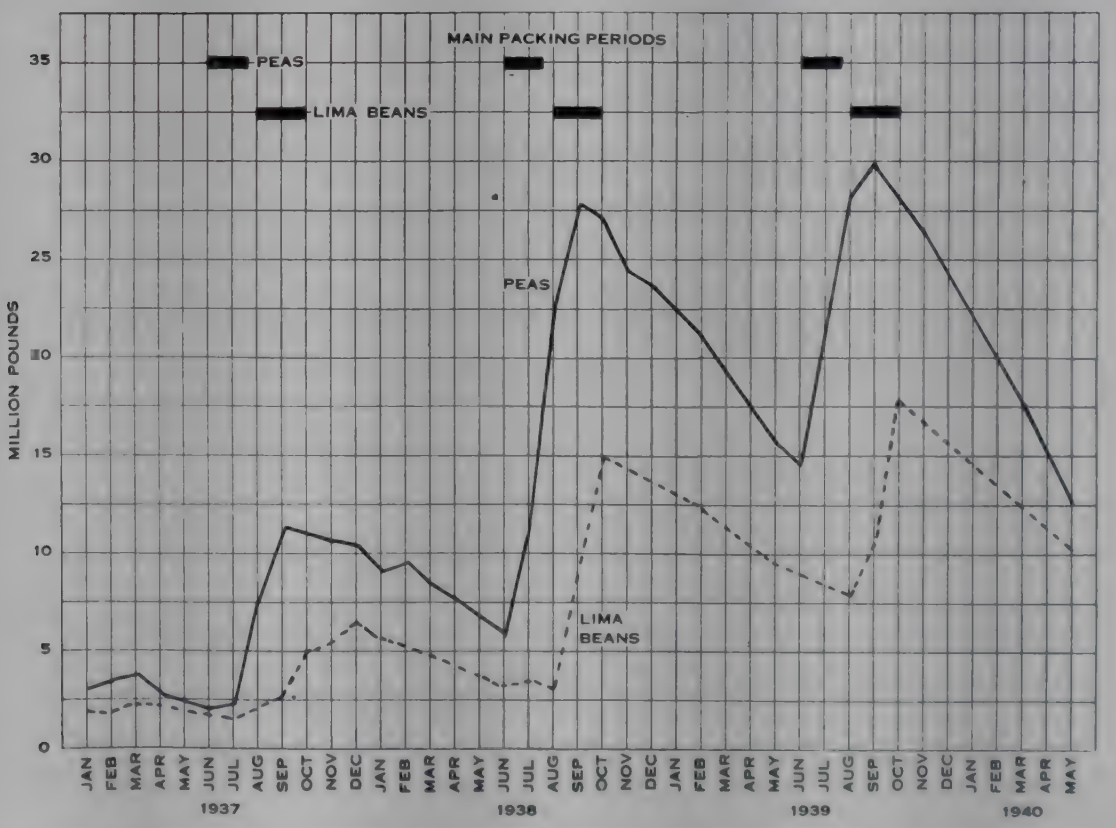

Fig. 6—Reported cold-storage holdings of quick-frozen peas and lima beans in the United States. U. S. Dept. of Agr.

The Bureau's reports probably furnish a fairly accurate record of the low and peak stock periods and the rate of flow in and out, and, comparing one year with another, give some indication as to the relative activity in the production and sale of the various products and the relative distribution of the stocks so far as holdings in the various geographic divisions are concerned. The Bureau is constantly increasing the value of its reports by adding items and subdividing the classes and locations of the stocks.

Figures 4, 5, 6, and 3 show graphically the Bureau's cold-storage holding reports covering frozen strawberries, cherries, peas, and lima beans, and total vegetables, each month during the years 1937, 1938, 1939, and the first 5 months of 1940.

It is probable that the percentage coverage varies for different sections. It was observed that there were heavy holdings of frozen products in private warehouses on the Pacific Coast; and these warehouses generally advised that they were not reporting to the Bureau. On the other hand, a major part of the heavy South Atlantic strawberry pack and the eastern cherry pack is immediately placed in public warehouses. For that reason the cold-storage reports probably give a better indication of the eastern than of the Pacific-Coast pack.

It is apparent that the Bureau's cold-storage reports should not be accepted as an absolute index either of volume of pack or stocks on hand. The reports, however, are the only national statistics covering the frozen-food industry, and it is to be hoped that means will be found to increase their coverage. Better cooperation from the frozen-food industry would help.

FROZEN-FOOD MARKETS

The frozen-fruit and -vegetable packer has three general markets for his products:

1. Processors' market.—As raw material for processing into other food forms, mainly preserves, ice cream, pies, and soda-fountain supplies. Frozen strawberries, cherries, blueberries, and other small fruits, and peach and apple slices, are packed for this market in containers of various sizes ranging from 450-pound barrels down to 30-pound and smaller containers, of different types.

The small packs of vegetables now being made for canners and soup manufacturers come under this market classification.

2. The institutional trade.—Hotels, restaurants, ships, institutions, all places where meals are served to the public. Packaged mainly in 2½- and 5-pound units, but larger packages also are used.

3. The retail trade.—Homes. Approximately 1-pound packages. Fruits, vegetables, meats, poultry, fish—all foods that can be frozen satisfactorily for retail delivery.

Fruits for processors are known to the trade as "cold-pack," "frozen-pack," "frozen-bulk-pack," and by other more or less descriptive names.

Foods frozen for the retail and institutional markets have been called "quick-frozen," "carton-pack," "fresh-frozen," "frosted," and other descriptive names—many of them adopted originally to distinguish the new frozen foods from cold-storage products. None of the names are necessarily accurately descriptive, but usage has identified "quick-frozen" and "carton-pack," or "quick-frozen-carton-pack," with the foods frozen for retail and institutional distribution.

These markets overlap, the 30-pound and smaller cold-pack containers going to both the processing and the institutional trade. Likewise, the institutional trade may purchase the small retail carton for short orders or other purposes, and the housewife frequently buys the larger packages for special occasions or for making preserves or jelly.

MARKET REQUIREMENTS

Cold-pack, single-frozen, or quick-frozen products are all being accepted by the users of the 30-pound and smaller-unit packs, but purchasers are beginning to discriminate, demanding the type of product best suited to their requirements. They are not interested in the exact freezing methods by which the desirable characteristics may have been attained. That is the packer's problem. For example, the preserver requires a medium-sized, bright-colored, acid strawberry which will not go to pieces during the cooking process; the ice-cream manufacturer is more interested in flavor than in size, shape, or acid content, and

may prefer sliced, sugar-soaked berries; the retail trade and, for some uses, the institutional trade, prefer the full-flavored, bright-colored, sweet, dessert type of berry.

As the industry expands and the trade becomes familiar with the possibilities of the proper combinations of variety, preparation, and freezing, the demands of the various markets undoubtedly will become more exacting.

PROCESSORS' MARKET FOR COLD-PACK FRUITS

A comprehensive coverage of the frozen-pack market was not attempted in the 1937-38 survey, and the following information is based on the 1935 survey, with comments on the major changes which have since taken place.

The processors' market is the most important frozen-fruit market from the quantity standpoint, but is limited by the demand for the finished products for which the frozen fruits provide the raw material. The bulk of the production is packed in 450-pound barrels. The market for the barrel-pack consists of comparatively few buyers, who purchase in large quantities, and whose consumption varies with the demand for their products, which in turn fluctuates with the ups and downs of consumer buying power.

Strawberries

It will be noted from table 3, which gives the quantities of the various fruits packed in 1935 and 1937, that strawberries constituted 48 percent of the 1935 pack and 41 percent of the 1937 pack.

TABLE 4—*Location, consumption, and use of cold-pack strawberries.*
Packed in 450-pound barrels—1935 market survey.

Location	Consumption—No. of barrels			
	Total	Preserves	Ice cream	Pies
Louisville	525	450	75	----
St. Louis	4,630	4,500	130	----
Indianapolis and vicinity	2,083	2,000	83	----
Chicago	7,470	6,320	1,150	----
Detroit	600	----	600	----
Cleveland	6,725	6,100	625	----
Cincinnati	1,720	1,650	70	----
Pittsburgh	3,565	3,150	415	----
Southwestern New York	3,000	3,000	----	----
Buffalo	100	----	100	----
Rochester	4,580	4,500	80	----
Syracuse	95	----	95	----
Utica	20	----	20	----
Schenectady	15	----	15	----
Boston	5,160	3,800	1,360	----
New York	18,840	17,200	1,290	350
Philadelphia	10,150	8,450	1,700	----
Baltimore	2,975	2,500	475	----
Washington	300	----	225	75
Richmond	140	----	140	----
Total	72,693	63,620	8,648	425

Table 4 indicates the location and relative values of the main markets for barrel-pack strawberries, and also shows the importance of the preserve market as compared with ice cream, and the minor use of the barrel-pack for pies. A less complete survey was made of the consumption of strawberries packed in 30-pound tins (table 5). Here a reverse condition exists. Preserves account for approximately 85 percent of the barrel-pack and an estimated 65 percent of the entire strawberry pack; but 80 percent of the 30-pound tins located went into the pie and hotel trades, with only a minor use by the preserver.

TABLE 5—*Location, consumption, and use of cold-pack strawberries.*

Packed in 30-pound tins, reported by consumers and jobbers, together with brokers' estimates—1935 market survey.

Location	Consumption—No. of tins				
	Total	Preserves	Ice cream	Pies	Hotels
Indianapolis	1,000	———	1,000	———	———
Chicago	915	———	650	150	115
Detroit	11,500	———	750	10,750	———
Cleveland	1,000	———	500	500	———
Cincinnati	2,000	———	500	1,500	———
Pittsburgh	2,750	———	1,175	1,520	55
Buffalo	2,450	———	950	1,500	———
Rochester	1,000	———	———	1,000	———
Syracuse	250	———	———	125	125
Albany	1,000	———	———	1,000	———
Boston	6,300	———	1,800	2,500	2,000
New York	12,400	800	100	5,400	6,100
Philadelphia	3,000	———	———	2,000	1,000
Baltimore	2,500	———	———	1,500	1,000
Washington	2,000	———	2,000	———	———
Total	50,065	800	9,425	29,445	10,395

In 1935 the eastern pie bakers removed from our fresh-strawberry markets about 3,600,000 pounds of berries and froze them in the crate in local cold-storage warehouses for future use. During the same year the northwestern packing states were experimenting with a capped and cleaned single-frozen strawberry pack, with the eastern pie trade in mind. We have no information as to the quantity of crate-frozen berries used in the East in 1937, but in that year the Pacific Northwest increased its single-frozen strawberry pack to 1,761,000 pounds. Alabama packers took advantage of the pie market for strawberries and packed single-frozen, cleaned and capped strawberries in standard strawberry-shipping crates. One packer sold approximately 100,000 pounds to the midwestern pie bakers at 11 cents per pound. In 1938 they packed the berries in 20-pound waxed paperboard cartons.

Red Sour Cherries

The red sour cherry is mainly an eastern crop, and a major portion of it, in fresh, canned, or frozen form, is consumed by the pie trade. Red sour cherries are second to strawberries in volume.

According to the 1935 survey, 87.5 percent of the total pack went to the pie trade and 11.5 percent to the preserver, the remainder being accounted for by scattered reports of use by ice-cream manufacturers. The minor frozen pack of the Pacific Northwest increased slightly between 1935 and 1937, but it was estimated that the eastern packers of frozen cherries had increased their output from 15,000,000 pounds to about 30,000,000 pounds in 1937.

Red Raspberries

Red raspberries are third in volume of pack. Table 6 covers the important markets for the barrel pack, with practically the entire

TABLE 6—*Location, consumption, and use of cold-pack red raspberries.*[1]
Packed in 385-pound barrels—1935 market survey.

Location	Consumption—No. of barrels		
	Total	Preserves	Ice cream
Louisville	50	50	----
St. Louis	655	650	5
Indianapolis and vicinity	2,500	2,500	----
Chicago	2,860	2,850	10
Cleveland	3,430	3,425	5
Cincinnati	225	225	----
Pittsburgh	800	800	----
Rochester	225	225	----
Boston	2,678	2,670	8
New York	6,765	6,750	15
Philadelphia	1,645	1,570	75
Baltimore	750	750	----
Washington	18	----	18
Total	22,601	22,465	136

[1]All were Cuthbert from Northwest, except the 18 barrels of eastern pack located in Washington, D. C.

amount used by the preserve industry. Tennessee production has been of minor importance, but a new variety, Tennessee Autumn, recently developed by the Tennessee Agricultural Experiment Station promises satisfactory yield and quality and disease resistance.

TABLE 7—*Location and consumption of cold-pack blackberries.*[1]
Packed in 385-pound barrels—1935 market survey.

	Consumption—No. of barrels
Louisville	146
St. Louis	400
Indianapolis and vicinity	600
Chicago	325
Cincinnati	1,050
Pittsburgh	600
Boston	100
New York	2,050
Philadelphia	[2] 1,230
Total	6,501

[1]All cold-pack blackberries located were consumed by preserving industry.
[2]Includes 30 barrels of Black Diamond variety packed in the East.

Blackberries

The barrel-pack of blackberries is used almost exclusively by preservers, as shown in table 7. The smaller packs are used extensively by the pie industry. In Cincinnati and Pittsburgh, wild blackberries, mainly from eastern Kentucky, were being used for preserves.

Youngberries and Boysenberries

Youngberries and Boysenberries have not received the attention they merit, either as cold-pack fruits or quick-frozen dessert fruits. Preservers and pie bakers report that they have been unable to use them except as blackberries because of consumer unfamiliarity, and indifference to any new food which has not received extensive publicity and advertising.

Peaches

Peaches have reached an annual consumption volume of around 5,000,000 pounds, almost entirely taken by the ice-cream industry. This by no means represents the potential consumption of a high-grade pack which can be depended on not to discolor in storage. Preservers and pie bakers have reported that they would increase their frozen-peach purchases when the browning problem was definitely solved.

Apple Slices

Apple slices are one of the newest and most rapidly increasing items in the cold-pack list. The 1935 pack amounted to about 4,500,000 pounds, and had increased to 6,500,000 pounds in 1937. The apple as a pie fruit is in a class by itself in volume and all-year acceptance. The convenience of the sliced apple makes every pie baker and hotel or restaurant kitchen a potential customer, even though fresh apples are available all the year at relatively low prices.

Blueberries

Blueberries, a 5,000,000-pound item, used almost entirely by the pie bakers, are nearly all imported from Nova Scotia and Newfoundland. These imported berries are a fine pack, carefully cleaned and graded, of uniform ripeness and size, dark blue, and meaty, with small seeds. In 1935, we imported approximately 4,500,000 pounds, which was increased to 8,947,416 pounds in 1937. This heavy importation flooded the market, and there was a heavy carry-over into 1938. The 1938 importations dropped to 4,166,690 pounds, only slightly less than 1935 despite the reported heavy carry-over.

Preserve Industry

Cold-pack fruits have practically replaced canned and fresh fruits in the preserve industry, and no reason is now apparent for any spectacular increase in their consumption. The preserving trade con-

sumes so large a proportion of the barrel-pack of strawberries and other preserve berries, that it has become a controlling factor in this branch of the frozen-food industry. Other industries do not use sufficient quantities to absorb the shock of the fluctuations in preserve consumption, and both grower and packer are dependent on the preserve trade, not only for volume but for price received. Cherries, apple slices, and blueberries are affected similarly by fluctuations in the pie industry, which is directly affected by consumer buying power.

Ice-Cream Industry

The ice-cream industry takes approximately 12 percent of the total barrel-pack of strawberries. Cold-pack fruits, with the exception of peaches, have generally replaced canned and fresh fruits. The use of frozen fruit in ice cream might be increased by increasing the popularity of fresh-fruit ice cream. Unless the total consumption of ice cream can be increased, and not simply a shift made from other flavors, the ice-cream manufacturers cannot be expected to show much interest in putting on advertising campaigns to sell more fruit flavors.

Pie Industry

The pie industry is not a factor in the barrel-pack of strawberries, accounting for less than 1 percent of the total production. In 1935 it utilized an estimated 5,000,000 pounds of barrel- and tin-pack and crate-frozen strawberries; approximately 15,000,000 pounds of frozen red sour cherries, 4,500,000 pounds of frozen apple slices, 5,000,000 pounds of frozen blueberries, and small amounts of frozen peaches, blackberries, and red raspberries. Not having been as thoroughly converted as the preserve and ice-cream industry to the use of frozen fruits to replace fresh and canned fruits, also taking into consideration the relatively large amount of fruit contained in a serving of pie, the pie industry is a much better prospect for increased sales. The increased production of pie fruits from 1935 to 1937 (table 3) is evidence of this fact. The price of frozen fruit, as compared with other pie filling, and consumer tastes, will be controlling factors in the further expansion of this market.

Future Markets

It should be possible to expand the distribution of the 30-pound and smaller packs of all frozen fruits to the institutional trade and to the relatively small ice-cream manufacturers and pie bakers in the less densely populated and partially neglected markets of the Southeast and other sections of the country.

While the markets for cold-pack are practically stabilized and do not have the almost unlimited possibilities for expansion presented by the quick-frozen retail markets, they do offer opportunities for better products coupled with good salesmanship. It should not be difficult,

for instance, to convince preservers or pie bakers of the fine preserve and pie characteristics of the Blakemore strawberry as grown in Tennessee. Neither should it be difficult to demonstrate the quality of the "single-frozen" berries as now frozen without sugar by the improved air-blast freezers on the Pacific Coast, or the high quality of the products frozen by the Tennessee immersion freezer. This type of pack should aid greatly in the immediate future expansion of this market.

INSTITUTIONAL AND RETAIL MARKETS

The institutional and retail markets, broadly speaking, are the present markets for both canned and fresh-food products. What proportion of these markets will be taken over ultimately by quick-frozen foods depends on future developments. Quality, price, and availability are the natural competitive factors. The increase in war threats may make hazardous a too great reliance on a method of food preservation which depends on the uninterrupted maintenance of electric power wherever the food may be stored. Natural catastrophes, by causing power interruptions, could destroy large quantities of the food supply of affected areas.

Institutional Market

The institutional market comprises all places which serve meals to the public and purchase food in larger units than are customary in the retail trade. The accessibility of this market in any particular locality depends on the storage and distribution facilities available for the economical handling of the frozen food. Through ice-cream and other distributing agencies, institutional distribution has been extended into the less densely populated parts of the country until, theoretically, the entire market has been opened up to distribution.

This does not mean that there is no room for further expansion in the institutional trade. Institutional distribution is by no means limited to the high-priced hotel and restaurant dining rooms. The drugstore and the "five and ten" lunch counter, the small tea room, the "pullman diner," and small roadside stand, are examples of institutional outlets which have become important consumers of frozen foods of all kinds. Frozen food appeals particularly to places having limited kitchen space—they do not have to devote space or labor to shelling peas, or sorting and washing spinach. The "five and ten" and the corner drugstore can serve a tasty, inexpensive, well-balanced "plate" meal, with a minimum of kitchen space and equipment. With modern mechanical refrigeration, the roadside stand can keep hamburg steak or fish for indefinite periods without fear of spoilage. They can order in quantity, and will sell more, owing to greater consumer confidence. Steamships, especially on long cruises, are increasingly taking advantage of frozen foods to serve better fresh vegetables and other foods. Naturally any lowering in production

costs and consumer prices will add appreciably to the number of small consumers who feel that they can afford to use quick-frozen foods.

Retail Market

The principal market for all foods is through the more than 600,000 retail food outlets, serving approximately 30,000,000 families. According to informed estimates, only 12,000 of these retail outlets were selling quick-frozen foods on January 1, 1940.

Frozen foods are not limited to any particular class of retailers. They are being sold in grocery stores, meat markets, fish markets, fresh-fruit and -vegetable stands, delicatessen stores, dairy stores, food departments of department stores, drugstores, ice-cream stores, and confectionery stores, as well as by house-to-house sales organizations.

They are especially adaptable to small retailer distribution. Any retailer who has a low-temperature storage cabinet can sell this almost complete line of fresh foods—fruits, vegetables, meats, poultry, and seafood—all compactly packed and requiring little if any display other than posters and price lists. With daily deliveries, any retailer can stock quick-frozen foods by using a floor space less than 3 feet wide by 7 or 8 feet long. Practically all other classes of foodstuffs are being sold in small, convenient packages, except green salad items and the root crops, and these undoubtedly will follow the trend toward clean, prepared, packaged goods. Refrigeration space for packaged tomatoes, lettuce, and other perishable fruits and vegetables not now being frozen may become an adjunct to the low-temperature storage cabinet.

The increasing number of freezer-locker installations, if operated at a uniform temperature of about 0° F., not only provide possible storage for commercial packs of frozen foods, but are potential sales outlets to both institutional and retail consumers in areas where other facilities are not now available.

Proportioning the Pack between Institutional and Retail

Because of the limited facilities now available for retail distribution, and the difficulties in covering the retail market, it is natural for the new packer to look to the institutional market for his immediate sales. During 1938, there were about 110 packers of quick-frozen foods, but only a small percentage were supplying the retail trade under their own brand name. A large part of the increased production of that year was packaged for the institutional trade.

Many distributors were of the opinion, early in 1939, that this market had become practically saturated, and they believed that packers should look to the retail market for future expansion. Personal observation and interviews led to the conclusion that if this was a fact it was saturation at prevailing prices in competition with low-

priced fresh and canned products, and that a much greater market would be opened up at prices more nearly competitive with canned goods and with fresh foods in season. Probably the 1937-38 carry-over situation was partly responsible for the distributors' opinions.

Up to 1937 it was generally considered that frozen-food sales were divided 70 percent institutional and 30 percent retail. In the fall of 1937, leading distributors reported that 60 percent of their total sales were through the retail stores. This percentage will increase as retail outlets are opened. One prominent packer and distributor reported 50 percent increase in output during 1938, practically all of which was due to the expansion in retail sales. Since the retail market accounts for the greater part of our food consumption, quick-frozen foods naturally will follow along practically the same ratio as other food forms as fast as the retail cabinet situation is solved and proper distribution channels are opened up.

THE 1937-1938 CARRY-OVER

Interviews with packers and distributors in various sections of the country in the fall of 1937 indicated the greatest optimism concerning the future of the industry, and plans were being made for substantial expansion. Brokers and distributors reported unfilled orders, deliveries in some cases being as low as 50 percent of the orders. Later in the season the reaction from over-optimism set in and for the first time rumors of a heavy carry-over and its effect on the industry were heard. Government storage-holding reports indicated a slow movement of frozen foods compared with previous years and a heavy carry-over into the 1938 packing season.

Replies to a questionnaire sent out in August, 1938, to executives of the industry in packing and distributing centers, suggested that the carry-over was due mainly to the poor quality of part of the pack and partly to overpacking for the institutional trade. Further, more complete Government reports of holdings than for previous years may have given the trade an exaggerated idea of the comparative size of the carry-over. An analysis of the situation, with the assistance of these replies, indicated that the carry-over of quality packs for both institutional and retail distribution had not seriously exceeded the safe margin necessary to insure adequate supplies until the new 1938 pack came on the market.

Any packer now entering the quick-frozen-food business should first locate his market, guard against overpacking for the institutional trade, and look for ways of providing for expansion through the retail trade. There still are sections of the country, particularly in the Southeast, which offer opportunity for expansion in both trades. Packers entering the business should not overlook their home or nearby markets.

GENERAL SALES POLICIES

COLD-PACK FRUITS

The northwestern packers follow a consistent and effective method of distribution. They establish connections with leading food brokers in the important centers of frozen-fruit consumption, and these brokers, in effect, are the packers' sales representatives. The brokers work on a commission of 4 to 5 percent on all sales, bearing their own sales expense. This arrangement gives the packer the advantages of a district sales office in one or more of the important buying centers, at a predetermined percentage cost which is not payable until the sale has been made and payment received.

The packer sells through these brokers to jobbers and wholesalers whose credit standings have been established, and is relieved of risk as to the credit of the small buyer. The jobbers and wholesalers reported a write-up of from 15 to 30 percent, the average being approximately 25 percent.

At the time the 1935 survey was made, the eastern packers seldom followed established distribution channels, but sold through any and all channels. This practice encouraged large consumers to attempt to buy direct from the packers at less than prevailing prices. The adherence of all packers in a district to regular methods of distribution will usually go a long way toward preventing cut-throat price competition.

Eastern conditions differ from those in the Northwest on account of the nearby fresh markets and the proximity of the large users to the strawberry fields. In some cases large consumers do their own packing, either packing near the producing fields or buying surplus stocks of fresh fruits in their local markets. A few of these packer-consumers job or wholesale their excess, and cold-packing has become an important side line to their regular business. Many processors reported that they did their own packing because they liked the eastern berry but could not find a reliable source of supply; and some of them intimated that they would stop packing if a good eastern pack were available. Since 1935, standardized, quality, eastern-pack production has increased, notably the strawberry, red-cherry, and apple-slice packs, and established brokers are more generally employed in the distribution of the eastern pack.

Two large northwestern cooperative packers joined a commercial packer in a pool arrangement to be operated in case it is advisable to sell any part of their berries in the fresh market. This pool materially increases the flexibility of their control over the disposal of large quantities of berries for which they are committed to the grower.

The first step in the distribution of the output of many of the smaller northwestern cold-pack operators is through a local "field-broker." By combining several small packs, the field broker assem-

bles a sufficient volume to make carlot shipments and establish regular distribution through brokers located in the principal consuming centers—a distribution which would be difficult if not impossible for a single small packer to secure. The field broker usually works on a 1-percent commission basis.

Much of the barrel pack of fruit is sold in advance of packing. One of the largest northwestern packers limits this advance sale to 80 percent of his expected pack in order to have a part of his pack available to supply late orders or to take advantage of possible price increases. Other packers, including some of the largest operators in the East, pack only to fill orders received in advance. Some eastern packers are willing to take a chance on a rising market price for a part of their output, while others are not.

Generally speaking, the well-established packer, located where his supply of produce is assured, secures orders for practically all of his output through his regular brokerage connections well in advance of the packing period. One result of this method of distribution is that the greater part of the carry-over from one season to the next is held by the buyers, and the worst that can happen to the packer is that his next season's pack must be reduced to meet a lower demand. In some cases, buyers have been compelled to dispose of their excess as and where they could, often at a substantial loss. On the other hand, some buyers reported that in case of a shortage of frozen pack and a rising market, they could make more profit by selling their frozen-pack stock than by processing it.

QUICK-FROZEN FOODS

Birds Eye Sales Policies

It has been a fundamental principle of Birds Eye's sales policies to extend distribution slowly, first to the institutional and then to the retail trade. This was necessary, not only to make sure of consumer acceptance in each new distribution center, but to insure that the volume of pack kept up with the increased sales. During this promotional period, advertising was limited to local newspapers and to short radio announcements in Chicago, New York, and other large distribution centers. January, 1940, saw the first national advertising used for the sales promotion of quick-frozen foods.

In distributing to the institutional trade, Birds Eye generally makes an exclusive territorial agreement with a wholesaler or jobber who is well established in the food business and is catering to the hotel and restaurant trade. The wholesaler buys the products outright, usually in mixed carlots. He stores in a local public cold-storage warehouse, but usually maintains storage space on his de-

livery platform for holding a stock sufficient for daily deliveries. His contract seldom includes retail sales. The wholesaler sets the price at which he sells to the institutional trade by marking up his cost 18 to 20 percent.

In reaching the retail trade, Birds Eye's general policy is to omit the wholesaler and deal direct with the retailer. This policy is applied in the dense retail districts of the large cities. In smaller cities, where Birds Eye cannot profitably maintain its own delivery and collection services, arrangements are made either with its institutional distributor or with some other wholesaler to handle the delivery, billing, and collections. For this service Birds Eye pays a commission of 10 percent of the sales to the retailers.

Under this arrangement all retailers contract direct with Birds Eye instead of with the local distributor. The retailer rents a cabinet from Birds Eye and agrees to sell no other manufacturer's frozen food through it. This arrangement uses the local wholesaler's delivery and collection facilities, but otherwise leaves the retail distribution entirely in Birds Eye's hands. The sales department calls on all retailers, every 10 days or two weeks, not to take orders but to keep a general eye on the situation and to offer suggestions regarding methods of handling and selling.

Prices are kept as nearly uniform as possible all over the country throughout the year. Large buyers, such as national chain stores, do not get price concessions, but wholesalers who place advance orders in volume are granted slightly lower prices. The Company has been using a plan of weekly retail special sales, by which items that are moving slowly or have a particular seasonal appeal at the time are reduced about 2 cents a pound.

Retail Cabinet Policies

Birds Eye has been the only frozen-food distributor owning the retail cabinets through which its products are sold. A few of the original high-priced cabinets, however, were purchased outright by dealers. Recent reports have indicated that the Company is trying out other methods of handling the cabinet problem, and that in at least one area it is selling the cabinets. This is a radical departure from its established policy. Another departure is to allow a desirable dealer who already owns a cabinet to use his cabinet instead of renting one when he becomes an exclusive Birds Eye dealer. These breaks in policy probably have been forced by the natural developments of greatly extended distribution, both by Birds Eye and others. Birds Eye still insists on an exclusive dealership arrangement, but this limitation will become increasingly difficult to enforce, especially where cabinets are owned by the retailers.

The policy of renting cabinets to retailers not only necessitates a heavy investment, but means that the distributor must maintain a large and complete stock of fruits, vegetables, meats, seafood, and poultry. Few packers, even if they wanted to follow this policy, are prepared either to make the investment or to supply a complete line of frozen food. Birds Eye, because of its dominant position in the industry, its financial ability to own the retail cabinets, and its ability to provide a complete line of excellent frozen products, has so far been able to limit its retailers to the sale of Birds Eye products.

Honor Brand, which at the time of the 1937-38 survey was the second largest distributor of frozen foods, did not burden itself with the investment and responsibility involved in owning and renting retail cabinets. The retailers were expected to buy cabinets from one of two manufacturers, and Honor Brand arranged to have its trade-mark displayed on the cabinets, regardless of the fact that they were purchased by the retailer direct from the manufacturer, who financed time payments and serviced the cabinets. In some cases the distributor actually secured the order for the cabinet in the name of the manufacturer at the time he arranged with the dealer to sell Honor Brand frozen foods. Since Honor Brand did not own the cabinets, it had to depend on its ability to furnish a complete line of standard-quality frozen foods to retain the exclusive sales arrangement.

The cabinet is the key to retail distribution, and a cabinet closed to all except one manufacturer's or distributor's product might be compared to a grocer's shelves exclusively owned or controlled by one canner or canned-goods distributor. Outlets for quick-frozen foods established by the exclusive-cabinet system are not additional outlets for the independent packer, but on the contrary he may find the cream of the retail sales outlets in a given locality closed to him by the installation of exclusive cabinets.

The packer or distributor of a few items, or of limited quantities of a number of items, cannot guarantee to keep the retailer supplied with a complete line of frozen foods. He therefore finds it exceedingly difficult to persuade the retailer to invest in a cabinet and handle his products. It is much better sales sense for the retailer to take up a complete, established line of quality products. If the retailer attempts to use installed dairy or meat refrigeration facilities, the high temperatures inevitably result in deteriorated, if not thawed, products which reflect on the packer's or distributor's brand name. The ice-cream cabinet has provided a temporary solution to this problem, especially for limited distribution in small neighborhood stores. The round-hole type is inconvenient for the rectangular packages, but the low temperature protects the quality of the product. Cabinet manufacturers are attempting to meet this difficulty by developing efficient cabinets which can be sold at reasonable prices, and many of them are financing and servicing the cabinets, enabling the retailer to install his own cabinet and handle whatever frozen products he desires.

Many independent packers and distributors were extremely critical of these exclusive-cabinet policies, but there is something to be said on the other side of the question. Birds Eye went through a long, expensive pioneering stage before it received any return on an extremely heavy investment. It can hardly be expected to forgo the advantage of the closed cabinet and open up the retail distribution, which it has established by hard experience and heavy expense, to all packers and distributors on an even footing with its own products. Inevitably, as more standard-quality products become available, Birds Eye will be forced to change its policy and give up this advantage. If the closed-cabinet policy delays the expansion of retail distribution, some authorities believe that that may not be without benefit to the industry as a whole, by serving as a check on the production of inferior-quality products by inexperienced, irresponsible packers.

The ice-cream manufacturers have faced a similar cabinet problem, and there is a diversity of opinion as to the proper method of handling it. Some manufacturers place a cabinet in a retail outlet and keep it filled at a base price per gallon slightly higher than would be charged a retailer who owned his cabinet. This results, in effect, in the rental of the cabinet on a per-gallon basis. Store-owned cabinets, of course, are open to free competition.

The Coca Cola Company's retail cabinet, used for chilling bottled goods, presents a problem similar to that of the retail frozen-food cabinet. The Company has two types of cabinets, the mechanically refrigerated coin-operated dispensing cabinet and the usual ice-cooled cabinet. The coin-operated cabinets are owned by the Company and are serviced and locked by the drivers. These are placed only in locations where specified minimum sales can be and are made. The ice-cooled cabinets are sold to distributors, who in turn sell them to the retailer, all sales being at cost, either on time payments or on a price per case of goods sold. The locked cabinets can be restricted to Coca Cola, but cabinets sold to the retailer are under no restriction as to their use for competitive goods, and none could be enforced. The Company recognizes the fact that only lock and key keep competitive goods out of Company-owned cabinets. Low prices and the attractiveness of the cabinets are depended on to make the sale, and the prominent display of the Company's trade mark on the cabinet puts competitors at a disadvantage.

Undoubtedly this cabinet situation will work itself out—and the open cabinet seems the only practical solution.

Sales Policies of Other Packers and Distributors

Honor Brand, the second largest distributor of frozen foods in 1937, did no packing, but distributed a complete line of frozen foods packed by various processors. It depended entirely on wholesalers for

distribution to both the institutional and retail trades. In some centers one wholesaler handled both, while in other localities the institutional and retail trades were handled by different wholesalers. Honor Brand used "suggested" price lists and sold outright to the wholesaler at about 20-percent discount. The wholesaler in turn sold to the retailer at about 25-percent discount from a "suggested" consumers' price list. Advertising was limited to local newspaper announcements. Since Honor Brand was taken over by Stokely Brothers & Company, they have supplemented their own frozen products with items supplied by other packers.

In contrast to Birds Eye's comprehensive organization for distributing as well as packing a complete frozen-food line, are the large and small packers who pack a relatively small volume or a restricted line of products and may or may not have any established distribution facilities. Few packers can pack a complete line of quick-frozen foods efficiently and economically. Yet if they or their distributing agencies are to compete with Birds Eye and Honor Brand for retail outlets, under present retail-cabinet conditions, it is almost imperative that they have a complete line to offer the retailer.

The cold-pack operators of the Northwest established first institutional and then retail distribution through the brokers who had been handling their cold-pack production. The brokers "sold" the idea of distributing quick-frozen foods to wholesalers who were established in the institutional trade. Eastern packers of cold-pack fruits who decided to enter the new business as distributors, and did not have eastern sources of supply for a complete line, bought northwestern packs put up under their own brands.

These packers generally make use of brokers at a commission of 4 to 5 percent to handle their sales in the various markets. The broker may make advance sales to eastern distributors, who will have the goods packed under their private brands, or he may make exclusive arrangements with a wholesaler in his territory. These wholesalers may have their own brands, or may sell under the packer's brand if he can provide a sufficient volume and variety of product. Usually the retailer buys any cabinet he wishes and is under no contract. In this method of distribution we see a trend toward the established merchandising practices employed in food distribution, through the retailer-owned cabinets which will be as open to competing lines as the grocer's shelf.

There are many variations of this general plan of distribution. A packer may decide to pack for local distribution only, if he finds his surrounding territory receptive. He may confine his distribution to a definite locality served by a wholesaler, jobber, or an ice-cream manufacturer or meat packer—any food distributor, who has low-temperature storage and distributing facilities—packing under either

the distributor's private brand or his own brand name. The cabinet problem is the responsibility of the local distributor, and many distributors, even in fairly large communities, solve it temporarily at least with available ice-cream cabinets.

Criticisms of the General Distributor

The so-called "general distributor" has been severely criticized, not only for his closed-cabinet policies, but as an unnecessary link in the chain of frozen-food distribution. To some extent the criticism is justified, although in this early stage of the new industry the general distributor is performing a useful function. Before the wholesaler will provide cold-storage facilities and refrigerated trucks, or the retailer will go to the expense of installing a cabinet, he wants to be assured of a complete line to sell. The general distributor, by placing large advance orders with many packers in various sections of the country, can offer the trade a complete line of products identified by his brand. If he did his own packing in one or two localities, his line would be incomplete. A vegetable-producing center, for example, usually cannot supply fish, meat, and poultry.

In many cases the packer looks to his broker to secure the orders from the general distributor. The goods are packed under the general distributor's name and sold by him to the wholesale distributor, or jobber, who in turn sells to the hotel or to the retail store. The arrangement enables a packer to supply part of a complete line of foods which may be sold under one brand.

Some critics put the Birds Eye organization in this "unnecessary" class, but this is not justified. Birds Eye not only has spent large sums in research and development, in missionary work and publicity, as well as in financing the cabinets for the dealers, but it owns the freezers in which the products are frozen and supervises and inspects the raw material used, maintaining a uniform and high standard of quality. Although Birds Eye usually packs in a canning plant and uses the canner's regular working force, it pays for the use of these facilities on a poundage basis, so that it is in effect a packer as well as a distributor.

It is doubtful, however, whether there is a place even in this young business for the type of general distributor who owns nothing but a brand, has nothing to offer but a desire to sell, and finances neither the retailer's cabinets nor the orders placed with the various packers. These distributors do aid in the distribution of retail frozen foods by providing their dealers with a complete line of products; and so long as the trade feels that they are necessary, just so long will they survive. The retailer-owned cabinets undoubtedly will be thrown open to competition as soon as reliable supplies become available from other sources.

When there are more packers having established brands and standards of quality, and any wholesaler can offer a balanced line made up of various brands, as is done today in filling the grocery-store shelf with canned goods, the business will settle down to distribution from packer through broker, to wholesaler, to retailer, as is the case now in the handling of other food products, and there will be little use for the general distributor.

PRIVATE BRANDS MAY BECOME A DANGER TO THE PACKER

The difficulties encountered in the distribution of frozen foods contributed to the growth of private-brand packing, and by 1937 private brands were being used to a surprising extent in the distribution of quick-frozen fruits and vegetables. Almost every packing plant and cold-storage warehouse had in storage brands owned by wholesale grocers, fresh-produce dealers, and other distributing agencies. The private cold-storage rooms of one of the largest northwestern packers contained 25 percent of his thousand-ton pea pack packaged in the cartons of one eastern distributor, a heavy private-brand pack for a midwestern distributor, and a number of smaller packs for other distributors who sold under their own private brands. Practically the entire pack was put up in private-brand cartons. The same was true of many other packing plants visited during the survey.

Packing for the private-brand trade undoubtedly is a tempting way to dispose of the packer's products. It involves large advance orders with little sales effort or expense. The product usually is paid for promptly, and responsibility ends on acceptance at the packer's plant. On the other hand, the packer of private brands is doing nothing to establish himself or his product in the trade. So far as the consumer is concerned, he does not exist. He depends on a few buyers to move the output of his plant and has no assurance that they will return to him the following year.

One large packer of private brands criticized Birds Eye's policy of packing its products in plants owned by canners or other processors, because this practice placed it in the dangerous position of having built up a large-volume, nation-wide distribution without having packing plants over which it had absolute control, or which could not be closed to it by the owners. As a matter of fact the packer offering this criticism was in a more dangerous position. Birds Eye is keeping its trade name before the public, creating good will, and building up a permanent commercial distribution which can not be taken away from it. If necessary, Birds Eye can change its manufacturing policy and build its own plants without disturbing its distribution system. On the other hand, the private-brand packer's sales were dependent on the whims of a few customers, and he was building up nothing in the eyes of the public.

Private-brand packing has been a standard practice of even the largest canners who maintain their own nationally advertised brands on the market. Several large canners agreed that there was danger in going too far with it. In their operations, while they could not afford to ignore the private-brand business, they had established the policy of not packing more than 25 to 30 percent of their production under private brands.

CONSOLIDATED SALES BY GROUPS OF PACKERS

Small packers located in the same general area, each one packing a small volume or only a few products, secure the advantages of large packing operations by consolidating their sales in the hands of a single sales agency. In other words, they establish a single sales department for the group. The plan enables the group to make carlot shipments of mixed products and the aggregate pack is of sufficient volume to interest the better-class brokers and distributors in the market centers. The packers are relieved of all sales details and as a group have a more important position in the industry than any one of them would have if they operated independently. All products may be marketed under a single brand owned by the sales company, or each packer's individual brand may be used.

One group of five canners and packers of frozen fruits and vegetables, located in the Northwest, own an incorporated sales company which handles all their sales. The various products are marketed under the sales company's different brand names.

The usual brokerage fee is 5 percent on canned goods and 4 percent on cold-pack, but because of the larger volume available under the consolidated sales arrangement, they have in many cases found brokers willing to handle the representation for as little as 2½ percent, leaving as much as 1½ percent to apply to the expenses of the sales company. In nearly all cases some concession is made by the broker; but the owners are willing to contribute over and above the accepted brokerage rate if necessary, to support the sales company and obtain the marketing advantages of group selling.

Another consolidated sales company handles the output of various packers in Washington, Oregon, and California, through offices in Seattle and San Francisco. This company sells under the packers' brands, and in addition has its own brand under which it sells the products of several packers. It is reported to be the sales agent for six packers having a total production worth about $3,000,000 per year, and to be completing arrangements with one of the largest packers of frozen fish and other seafoods to pack consumer-size packages under its brands.

RETAIL CABINETS

The first retail cabinets were built especially for frozen-food storage in retail stores. They were large, cumbersome cases, costing from $1200 to $1800, which Birds Eye sold to its retail distributors. Only the largest well-financed grocers could afford them. These cabinets were expensive to operate, and with a few exceptions, even the largest grocers found the overhead and operating expense too high for the volume of sales, and many gave up the distribution. Subsequently the price was lowered to about $900, but still they were too expensive. About 1934, Birds Eye arranged for the manufacture of a low-priced storage cabinet, costing around $300, which was rented to the grocer at $10.00 per month, for storage of Birds Eye products exclusively. The cabinet is self-contained and can be plugged into any standard receptacle. Removable wire compartments facilitate access to the contents in any part of the cabinet. The cabinet has a capacity rating of 11 cubic feet, or about 450 pounds of Birds Eye packaged foods.

In 1937 and 1938, many reliable manufacturers entered the field, offering cabinets within a reasonable price range for sale direct to the retailer and on extended terms of payment. Several manufacturers of ice-cream cabinets had developed square-compartment cases for holding packaged as well as bulk ice cream. One manufacturer had a line of seven sizes in capacities approximating 2, 3, 4, 7, 10, 14, and 21 cubic feet, which he offered the retailer as frozen-food "chests." The price to the retailer in the fall of 1937 ranged from about $170 to $550. The same manufacturer developed, for retail frozen-food storage, three sizes of cabinets of approximately 10-, 14-, and 21-cubic-foot capacity. Including card display and price rack, these were delivered and installed for approximately $375, $435, and $500.

Obviously the only capacity rating that can be applied to retail cabinets is the net cubic feet available for storing the product. The size, shape, and weight of the retail cartons vary considerably, affecting the net weight which can be stored in a given space. When manufacturers give both weight and space, we find 18.4- to 23.4-cubic-foot cases rated at 600-pounds capacity and 19.5- to 23-cubic foot at 500-pounds.

The September, 1938, issue of *Food Industries* contains a directory of frozen-food cabinets. While acknowledged to be incomplete, it lists 28 manufacturers, offering 98 models, including 6 models for dry-ice operation. Of the 98 models, 2 are listed as having capacities less than 2 cubic feet, 32 range from 5 to 15 cubic feet, 31 from 15 to 25, and 8 have a capacity of over 25 cubic feet. Practically all models are equipped with automatic temperature control suitable for operation at or near zero; some with wide ranges, extending well below zero. Cork is used for insulation in the greatest number of models. The

specifications also include materials such as Balsam Wool, Temlock, Laminated Fibrocel, Kapoc, Celotex, and Pine Cork. One of the dry-ice models specified cotton as insulation.

DISPLAY CABINETS

The relative merits of display and "blind" cabinets has been a live subject of discussion in the industry. Of the 98 models listed in *Food Industries* directory, only 13 are of the display type. The first cabinets, which Birds Eye sold to its dealers, were display cabinets, but later models were closed and depended on colored lithographed cards for their consumer eye appeal. Birds Eye has continued using blind cabinets throughout the major expansion period of its retail business, and the second largest distributor, Honor Brand, also used the non-display cabinets in building up its sales.

Distributors and retailers of both Birds Eye and Honor Brand reported complete satisfaction with the non-display cabinets when interviewed in the latter part of 1937. None of the retailers interviewed exhibited any particular interest in display cabinets. In fact, many of them, especially in territory outside the central concentrated distribution sections, were delighted to have any cabinet which would hold their stock at sufficiently low temperatures. Even retailers using round-hole ice-cream cabinets did not express dissatisfaction, although of course the round compartments were inconvenient and uneconomical of storage space.

Practical considerations against the display cabinets are higher first cost and operating expense. According to reports, the original display-type Birds Eye cabinet required 6-8 kwh per day, as compared to 2-3 kwh for the non-display cabinet. This was partly on account of the size and type of construction. A more equitable comparison may be made of cabinets listed by one manufacturer in the *Food Industries* directory. A 19.6-cubic-foot blind cabinet weighs 1300 pounds and is operated by a ⅓-horsepower motor; a 20.7-cubic-foot display cabinet weighs 1700 pounds and is operated by a ½-horsepower motor.

Complaints have been made that the opened products in the display cabinet deteriorate rapidly. This deterioration was generally blamed on exposure to the lights inside the cabinet, but may be caused quite as much by dehydration. Apparently, if the display packages are not sold promptly they have to be thrown away—which brings up the question whether they should be sold at all. Obviously, if left on display too long, the dried, faded food will lose all sales appeal. Moisture-vaporproof packages with cellophane windows have been suggested to prevent dehydration.

In the final analysis any decision between blind and display cabinets rests entirely on the question of consumer eye appeal — the exceptionally fine appearance of frozen foods balanced against a greater expense for cabinet, power, and wasted food. The ice-cream industry does not use display cases or otherwise exhibit either its packaged ice cream or its novelties. Neither does the canner, except for an occasional display of samples packed in glass. Lithographed cards, can labels, and unfilled, labeled containers all are used with apparent success in merchandising packaged foods.

INSTALLATION AND MAINTENANCE

One large frozen-food distributor who leases cabinets to retailers contracts with local refrigeration maintenance concerns to maintain these cabinets. It has been reported that this service costs from $7.50 to $9.50 a year per cabinet, and includes one or two general inspections but not the cost of any parts which may be supplied. The maintenance company guarantees service within 4 hours after being notified. If for any reason the cabinet cannot be put back in operation before the contents start defrosting, arrangements are made for putting dry ice in the cabinet to carry over until repairs are completed.

Some cabinet manufacturers have solved the service problem by standardizing on the refrigerating equipment of a manufacturer who has widespread service facilities, possibly for household refrigerators. For instance, one cabinet manufacturer advertises that its compressors are made by a company which has servicing agents in practically every distribution center, and when repairs are needed the local agency should be called. This same manufacturer announces that its cabinet operates from an electric-lamp socket and that anyone can install the cabinet by plugging in the cord. One distributor is reported to have an expense of from $10.00 to $15.00 for delivery of the cabinet from the nearest warehouse, as well as a $2.50 to $3.50 connection and adjustment charge. Installation and maintenance of retailer-owned cabinets probably will follow the various methods worked out for distributing electric refrigerators.

Retail ice-cream cabinets usually are owned by the ice-cream companies and maintained by their service departments. Their problem is similar to that of the frozen-food distributors who lease cabinets, but up to the present time they have had a much larger number of cabinets in a more restricted area.

A few retail grocers have complained of the cost and trouble involved in periodically defrosting the cabinet. Birds Eye instructs its dealers to defrost the cabinet at least twice during the summer and once during the winter. These instructions do not suggest an excessive amount of either labor or expense.

POWER CONSUMPTION AND COSTS

The power consumption of the modern 11-cubic-foot Birds Eye cabinet has been reported as 2 to 3 kwh per day. One cabinet manufacturer estimates that his 25-cubic-foot display cabinet consumes 7.7 kwh per day; another manufacturer estimates that his non-display cabinets will operate, with 250 to 400 pounds of frozen food, at 2.5 to 3 kwh per day; while a third states that it will cost, on an average, from $3.00 to $4.00 a month to operate his 13.5-cubic-foot cabinet, including the illuminated sign.

Taking the few instances in *Food Industries* directory where manufacturers have given information on the power consumption of their cabinets, we can strike an average as follows:

12 to 15 cubic feet, 3 to 4 kwh per day
15 to 20 cubic feet, 4 to 6 kwh per day

Estimates made by retailers in various sections of the country, covering widely varying power rates, sales volumes, and climatic conditions, averaged about $4.00 per month. One retail grocer said his Birds Eye cabinet cost him about $5.00 per month to operate. Other retail grocers placed their power costs at $2.00 per month—but this seems low.

INSURANCE

Insurance against power failure and the resulting defrosting and spoilage of food is a new development in frozen-food distribution. One instance has been reported in which the purchase contract for the cabinet included insurance against equipment failure and loss of stock. A premium of $11.00 insured the stock up to $75.00 for three years. Another insurance policy covers spoilage due to causes outside the cabinet itself, such as flood, fire, or breakdown of electric power. This policy covers an amount equal to the normal capacity of the cabinet, at a cost of $2.00 per year.

DRY-ICE CABINETS

Manufacturers of dry-ice cabinets claim the following general advantages:

1. Accurate, adjustable, automatic temperature control, within limits of 2° to 4° F., throughout a wide range, whether the ice bunker is full or practically empty.
2. No moving parts—nothing to wear out—repair and maintenance service unnecessary. No danger of breakdown when equipment may be needed most.
3. Low initial investment.
4. Low installation cost.
5. Conservative depreciation over a 10-year period.
6. Low net operating cost.

One manufacturer of mechanical cabinets is manufacturing dry-ice cabinets also. The dry-ice cabinet is cooled through the use of a secondary refrigerant, and the exhaust CO_2 gas is carried through the Kapoc insulation between the inner and outer shells, finally emerging at a relatively high temperature. It is asserted that the temperature can be held within 2 degrees, plus or minus, of the point at which the control is set. The control has a continuous adjustment from about -5° to +12° F. Reports on a comparative test of the operation of a mechanical ice-cream cabinet and this dry-ice cabinet indicated a more nearly uniform temperature from top to bottom of the storage space in the dry-ice cabinet than in the mechanical cabinet; also that a single charge of dry ice would carry the cabinet through an operating period of 115 to 120 hours, and that servicing twice a week was sufficient.

During this test the dry-ice cabinet consumed an average of 10.25 pounds per day, compared with 4.13 kwh of electric power for the mechanical cabinet. This would indicate the equivalence of dry ice at 2 cents per pound and electricity at 5 cents per kwh for these particular cabinets under the test conditions.

One automatically controlled dry-ice cabinet having approximately 3.6 cubic feet of storage space, costs the retailer about $62.00. Another dry-ice cabinet cools with an alcohol mixture circulated by a small motor-driven pump, which in turn is controlled by a thermostat. The manufacturers claim continuous adjustment from —30° to +50° F. In 1937 this cabinet, in the 9-cubic-foot size, was priced at $167.00 without display top, or $187.00 with display top. Their tests showed that at a holding temperature of 0° F. the standby loss was approximately 10 pounds of dry ice per 24 hours. One California packer expressed interest in this cabinet and was proposing to use it for retail distribution, servicing it about twice a week with both frozen food and dry ice at the same call.

Another western manufacturing company offers a line of several sizes of thermostatically controlled dry-ice cabinets, ranging in price, approximately, from $80.00 to $200.00. They advertise a temperature range from —20° to +15° F. They state that a 48-inch dry-ice cabinet with a storage capacity of 5 cubic feet, and a display compartment with a glass front 14 by 36 inches, in actual store operation, consumes an average of 12 pounds of dry ice per day at zero temperature, and that the smaller cabinets use from 7 to 10 pounds.

An executive of one of the largest dry-ice manufacturing and distributing companies said that up to that time dry ice had been used mainly for holding the temperature of precooled products during transportation, such as the shipment of ice cream or frozen-pack foods in relatively small quantities; and that he did not consider that dry ice could compete with mechanical refrigeration in stationary work, such as retail cabinets for frozen foods.

He stated that dry ice costs about 3 cents per pound delivered to the cabinet, which would require service about three times per week. A 6-cubic-foot cabinet consumes, on the average, 12 pounds per day (between $10.00 and $11.00 per month), while a similar mechanical cabinet will operate for an average of $5.00 per month.

This dry-ice company maintains, as far as possible, uniform prices over the country, and gives the following scale of prices:

	Cents per pound
Occasional users of small lots	5
Regular users of one ton or more per year	3
Users of 150,000 pounds or over per year	2½
Users of one million pounds or over per year	2 to 2¼

The company carries stocks in over 50 cities and maintains service to 142 cities of twenty-five thousand population and over.

On the other hand, California dry-ice distributors selling natural-well products from the Imperial Valley and Utah, quoted 1½ cents per pound to users of 1 ton or over per day; smaller quantities, 2 cents; and small retail lots, 2½ cents.

It appears that dry ice delivered to the cabinet at a cost slightly under 2 cents per pound can compete with the usual electric-power rates. Dry ice also will have the advantage of lower first cost for cabinets and lower cabinet maintenance and depreciation costs. Dry-ice cabinets are available with automatic temperature control which is not electrically operated, and therefore not subject to the hazards of power failure. With twice-a-week servicing of both dry ice and frozen food on the same call, the dry-ice cabinet seems to offer possibilities of low-cost, economical frozen-food storage for the small retailer.

HOLDING TEMPERATURES IN STORAGE AND TRANSIT

COLD-PACK FRUIT FOR PROCESSORS

In the frozen-pack fruit industry it was commonly accepted practice to store frozen-pack fruits at temperatures as high as 15° F. Specifications of the Northwest Fruit Barrelers' Association, issued in 1932, called for a temperature "not higher than fifteen degrees F." This applied to fruits frozen in bulk, mainly 50-gallon barrels, but also to smaller containers, including 30-pound tins, and a few still smaller containers, which were frozen either with or without sugar. The large units were slow to freeze and to defrost, and moderate fluctuations in storage temperatures were not considered detrimental to the quality of the product. Ordinary ice-refrigeration cars delivered these frozen-pack products to the northeastern markets at 18° to 20° F. and even higher. The fruit was placed in storage again at 15° F. until wanted for processing into other food forms, such as preserves, ice cream, and pies.

The revised Specifications, March 9, 1939, do not mention a definite temperature, but state under paragraph 6:

"All berries must have been so picked, packed and refrigerated as to length of time and/or temperature so that no softening, fermentation or spoilage might occur due to (a) time between picking and packing or (b) time between packing or refrigerating or (c) temperature of initial refrigeration or (d) packer's storage."

QUICK-FROZEN FRUITS AND VEGETABLES

The quick-frozen carton pack of fruits and vegetables for the institutional and retail trades required lower freezing temperatures. Loose or single-frozen packs were made, as well as solid-frozen. Vegetables were recognized as a more exacting product to store as well as freeze, and research was carried on to determine suitable holding temperatures. In particular the question arose of balancing length of blanch against a practicable commercial holding temperature.

Dr. M. A. Joslyn, of the University of California, in addressing the Sixth Conference of Pacific Coast Chapters, Practical Refrigerating Engineers, said—

"The growth of all micro-organisms decreases with decrease in temperature until a temperature is reached at which growth ceases. This temperature, the minimum growth temperature, varies with the environmental conditions, e. g., composition of medium, availability of oxygen, etc., and type of organisms.

"The lower limit for microbial growth is now believed to be somewhere between 15° and 20° F.

"Although a large percentage of the micro-organisms present, often over 90 percent, is destroyed by cold the surviving organisms remain viable for a number of years, and will develop at favorable temperatures. The destruction of the plant tissues usually allows a more rapid development of the micro-organisms present so that the spoilage of frozen food after defrosting is often more rapid than that of the original fresh product even though the frozen one contains a much smaller number of micro-organisms.

"The activity of enzymes is also retarded by decreasing the temperature. However, so active are the enzymes in promoting chemical changes and so resistant are they to the destructive effect of cold that appreciable deterioration occurs in but a few months in tissues stored at commercially available freezing storage temperatures. Enzymes have been found to be unaffected by exposures to the lowest temperatures investigated (400° F. below zero) and many of them are surprisingly active even in relatively concentrated solutions. Consequently they cannot be inactivated by cold alone.

"The undesirable changes brought about through the unchecked activity of the enzymes, however, may be minimized by storage at low temperatures, the lower the temperature the longer being the storage life of the product. The storage life is somewhat more than doubled for each decrease of 18° F. in temperature."

Smart and Brunstetter, in reporting their spinach and kale research,[1] say that while a storage temperature of 15° F. was found to be sufficiently low to protect the majority of their experimental packs from loss of desirable color, flavor, and texture, 0° F. is a safer temperature for commercial packing, particularly for long storage periods.

Operators of freezer-locker plants, visited in the Northwest in 1937, in which fruits, vegetables, meats, fish, and poultry were both frozen and stored, generally stated it was their intention to maintain a temperature of 6° to 10° F. The manager of one of the oldest and most successful locker plants, however, insisted on the importance of 0° F. with not more than a 5-degree variation.

In the Middle West, freezer-locker temperatures generally were reported as 10° to 15° and even 20° F., and many operators reported difficulty in keeping frozen fresh pork more than six months, while others experienced difficulty after three months, because the fat became rancid.

One research authority advised that tests had shown that frozen fresh pork keeps as well as other meats if held at 0° F. Asked why zero was generally becoming accepted as the proper holding temperature for frozen products, he replied that although not based on any

[1] *Food Research*, Vol. 2; No. 2.

conclusive research, zero had generally proved satisfactory for the long storage periods of the various products now being sold. He thought it possible that there was a particular temperature at which each product was best held during long storage periods, but knew of no research at that time which was conclusive on the subject.

West-Coast packers store their carton pack at —5° to +5° F. and generally 0° F. is considered the proper temperature. The heavy Los Angeles pack of Youngberries and Boysenberries in 1937 was being held between 0° and +5° F. This also was the reported holding temperature for several of the California frozen-vegetable packs.

Birds Eye's instructions to its wholesale distributors state that the temperature should not exceed 10° F., and that lower temperatures are more desirable, particularly in holding for long periods. It suggests to its institutional customers that the ideal storage arrangement is a low-temperature storage cabinet which maintains temperatures from 0° to 10° F. Stocks of institutional and retail packs of frozen fruits, vegetables, fish, meat, and poultry are held by ice-cream manufacturers in their ice-cream hardening rooms at temperatures from 10° to 20° F. below zero. Birds Eye uses various ice-cream manufacturers as distributors, especially in the Southeast, and apparently has found no objection to the below-zero holding temperatures.

REFRIGERATOR CAR ICING

One northwestern ice manufacturer states that in shipping frozen products to the East he used as much as 30 percent salt in the bunkers and was able to deliver in New York at any season of the year at 8° to 10° F., while the usual method of icing has been known to deliver at as high a temperature as 35° F. The bunkers are filled and the cars precooled for 24 hours before loading. As the bunkers are filled, varying amounts of salt are used: the bottom quarter, 20 percent salt; then 15 percent; and the top quarter, 30 percent. In the Pacific Fruit Express cars a 25-percent salt mixture having a brine temperature of —10° F. produces a car temperature of +12° F. It has been found that if both bunkers are opened at the same time, the car temperature rises as much as 15 degrees, but if only one is opened at a time the rise is limited to 2 or 3 degrees.

The cars are loaded to within 18 inches of the roof, with an air space in the center of the load. The top, sides, and ends of the load are completely covered with corrugated fiber, on the principle that as the products are at 0° F. when loaded, they should be insulated from the car walls, using the icing to produce as low a temperature as possible around the load.

Interest has been shown in the use of eutectic brine ice in refrigerator cars. This ice is solidly frozen brine, containing approxi-

mately 22 percent salt, and having a melting point of —5.8° F. The use of eutectic ice with its definite salt proportion produces a uniformerly low temperature and eliminates the uncertainty of the ice-salt ratio in car icing. It is naturally more costly than plain water ice and at present is not generally available at re-icing stations.

DRY-ICE REFRIGERATION

The use of dry ice in refrigerator cars has been practically limited to experimental work. One test has been reported using a heavily insulated refrigerator car in which insulated metal bunkers were built in each end. These bunkers were loaded with 3,000 pounds of dry ice, sufficient to refrigerate the car for from 6 to 15 days, depending on other conditions, without re-icing. Car temperatures could be controlled by thermostatically operated dampers, holding temperatures as low as —20° F., with only 5-degree variations.

Several companies have experimented with dry ice as a refrigerant, cooling a liquid which is circulated through coils in the body of the car, truck, or cabinet. A small motor-driven pump controlled by a thermostat controls the temperature.

A West-Coast dry-ice distributor said it was possible to hold the temperature within a range of 3 degrees at any point between —30° F. and +50° F. Refrigerator-car companies have shown some interest in the experiments, and it was estimated that for such large-volume users, dry ice could be sold for $10.00 per ton, and that a car of fresh produce could be delivered to the East Coast at 40° F., without re-icing, on 1½ tons of dry ice. The distributor had no estimates covering low temperatures suitable for transporting quick-frozen products.

In considering possible expansion in the use of dry ice or eutectic brine ice in refrigerator cars, it must be remembered that the railroads now have heavy investments in terminal and re-icing-point facilities.

Refrigerated trucks using both dry ice and mechanical means of refrigeration are successfully employed in the shipment of less than carlots of frozen foods.

SELLING PRICES

COLD-PACK FRUITS

Preservers purchase so large a part of the bulk frozen-pack strawberries and other fruits that the conditions prevailing in the preserve industry practically set the price for frozen-pack fruits, especially the barrel-pack. During periods of low purchasing power, preserves are one of the first food items to be affected. Housewives turn to lower-priced sweets, and strawberry preserves become an unnecessary luxury. This condition prevailed in the late summer and fall of 1937, because of the rapidly increasing unemployment in the industrial sections. A Knoxville retailer was at that time selling a good grade of strawberry preserves at 19 cents per pound and apple jelly at 9 cents. The effect on the price of frozen-pack strawberries is illustrated by what happened to prices in 1937-38, which is characteristic of the ups and downs of the cold-pack fruit market.

By January 1, 1937, the northwestern packers had sold out practically all of their 1936 pack. Prices were high and preserve and ice-cream manufacturers were selling part of their holdings instead of processing. With practically no carry-over in evidence, so far as the packers were concerned, the 2/1 pack opened at 10½ cents, as compared with 7½ cents, which was the opening price for the 1936 pack. Contracts were made with growers averaging 8½ cents instead of the previous average of 5 cents. In July and August, 1937, 2/1 Marshall pack was quoted at 12½ cents.

In the meantime, Florida and Louisiana had packed over 15,000 barrels, which were put on the market at 1 to 1½ cents below the western opening prices. Norfolk, Virginia, packed about 20,000 barrels, followed later by an unusual pack of 6,000 barrels in Michigan. Many midwestern and northeastern processors bought southern and eastern packs for the first time. One large ice-cream manufacturer gave as his reason, that "the Northwest packers ran wild in their ideas of prices and something had to be done."

In the latter part of October, 1937, a New York City broker was offering 2/1 Marshall strawberries in 50-gallon barrels at 10½ cents f. o. b. West Coast, the same as the opening price the previous spring, after having accumulated storage charges for about four months. It was reported in the trade that the packers sold practically all of their 1937 pack, but owing to the slow movement of preserves in the latter part of 1937, the processors were left with a heavy stock on hand. Advance orders for the 1938 pack were at a substantially reduced volume, and the Northwest opened at 7½ cents.

Summing up the situation: The northwestern packers, guided by the fact they had practically no carry-over from the 1936 pack in their own hands, raised the opening price and the price paid growers for

berries. They apparently overlooked (1) the amount of stock held by the large eastern buyers; (2) an unusually heavy southern and eastern pack coming on the market at lower prices; (3) a willingness on the part of their old customers to switch to the eastern pack; and (4) the approaching low public buying power in 1937, which affected the market of their major customers, the preservers.

If the packers had reliable statistics concerning their industry, crop prospects, and general business conditions, they would be able to market their product in a more orderly manner, to the benefit of both the grower and the packer. One gathers the impression that quoting prices for the large volume of advance orders for cold-pack fruits is an annual guessing contest. Competitive conditions have forced both the packer and the preserver to a narrow profit leeway which leaves only the grower to absorb the shocks of the ups and downs of the business.

The *Western Canner and Packer* Yearbook for 1939 gives the following average opening prices for Northwest cold-pack strawberries packed 2/1 in 50-gallon barrels:

	Cents per pound
1927	10½
1928	9¼
1929	8¼
1930	10
1931	8
1932	4½
1933	8
1934	6½
1935	7
1936	7½
1937	10½
1938	7½

While the 1939 opening prices have not been published up to the time that this material is being prepared, other sources advise that the opening was 7½ cents. Advance orders for the 1940 northwestern pack indicate an opening price of approximately 7½ cents.

The price of the 2/1 barrel pack of strawberries is considered a base price, with a more or less fixed differential for the prices of the 3/1 pack in various sizes of tins. The *Western Canner and Packer* list for recent years shows the following additional prices above the quoted barrel prices:

	Cents per pound
30-lb. tins	1 to 1½
15-lb. tins	1¾ to 2
10-lb. tins	2¼ to 2½

On the other hand, one of the leading eastern authorities gives the differential for 30-pound tins as ½¢ and for 10-pound tins, 1¢.

QUICK-FROZEN FOODS

Market prices for fresh produce fluctuate widely on account of seasonal production, although prices have been narrowed to some extent by modern methods of storage and transportation, which permit transcontinental shipment and importation of out-of-season products. Canned fruits and vegetables sell at relatively stable prices throughout the year. Transcontinental shipment of quick-frozen foods can be made for about 1.5 cents per pound, and frozen food can be stored at 0° F. in cold-storage warehouses for about 1.8 cents per pound per year. Even at these relatively high rates as compared with canned goods, fairly stable prices for quick-frozen foods seem feasible. In sparsely settled or remote districts, where it is necessary to deliver small quantities by refrigerated truck, costs, and therefore prices to the consumer, naturally will be higher than in the larger cities, where carlot shipments can be made and low-temperature storage is available. Even in these districts, the rapid spread of freezer-lockers opens up possibilities of carlot deliveries and stable prices.

Even in the early days of the industry, prices were found to be fairly close in widely scattered districts. The 2½-pound institutional pack of green peas was selling in Denver and Detroit, in October, 1937, for 22½ and 23 cents per pound; and in Miami, in January, 1938, for 24 cents; and, in the same cities on the same dates, sliced strawberries were selling for 25.2, 26, and 26 cents, and sliced peaches for 20, 22, and 22 cents. A remarkable uniformity in the market price of "fresh" fruits and vegetables in Denver, Detroit, and Miami, and in October and January.

Frozen sliced strawberries, consisting of Marshall variety from the West Coast and Missionary from Virginia and North Carolina, were being sold in Florida in January, 1938, for 35 cents per pound retail, and the peak of their sales was reported to coincide with the peak of the local fresh-strawberry production. In Atlanta, frozen strawberries at 35 cents per pound were successfully competing with fresh Florida berries at 20 cents per pint.

LOSSES IN DISTRIBUTION OF FRESH FRUITS AND VEGETABLES

If frozen fruits and vegetables are properly prepared, stored, and handled, there is no loss from packer to consumer. On the other hand, the perishability of fresh fruits and vegetables is a major problem in their distribution.

LOSSES IN THE RETAIL STORE

That quick-frozen foods are not subject to the "usual 25 to 30 percent spoilage loss in the retail store," has been advanced as one of the reasons why the frozen product would be able eventually to compete with the fresh on a price basis. No reliable figures were obtainable to prove that such high losses actually occur in the retail store. Retail losses are caused by shrinkage in weight, trimming to improve appearance, price reductions to speed up the movement of goods in danger of spoiling, and by unsalable stock. Some retailers buy quality produce, others buy on a price basis. Then, there is the question of the treatment the produce receives in the retailer's market and of purchasing in suitable quantities to insure a quick turnover of the stock. Losses vary widely with the seasons, and the temperature at which the produce is held. Some varieties deteriorate more rapidly than others—highly perishable peaches and strawberries, for example, as compared with the root crops.

Executives of several chain grocery-store systems were asked regarding their experience with losses of fresh fruits and vegetables in the retail store, particularly the products now most popular in the quick-frozen-food industry. The following are extracts from replies which were received:

"We regret that we cannot give you detailed figures covering the commodities mentioned in your letter, however, we can advise that the over-all loss on fresh fruits and vegetables, exclusive of potatoes, will average from 5% to 5.5%.

"The decay and spoilage on the vegetable group which would include all leafy and root vegetables, exclusive of potatoes, and fruits, will average approximately 7% to 7.5%.

"The decay and spoilage rate on fresh strawberries will approximate, including the loss taken in the way of price reduction, 10%.

"Peaches will average 7.5% to 10% depending upon seasonal growing conditions."

"We find that this information is not available on the individual items, but our experience shows that on the average we lose between 4% and 5¼% total in all stores.

"The top figure will represent the summer season and we expect that items like fresh strawberries will show a much higher proportion than this average."

"Unfortunately record of spoilage is not available by commodities but the following tabulation may be of value to you in your research:

Losses from spoilage—	Percent
Spring quarter	4½
Summer quarter	10
Fall quarter	7
Winter quarter	4½

"It is a matter of common knowledge that high temperatures are the chief cause of spoilage. This is particularly true of extremely perishable items such as fresh berries, peaches, and corn.

"The next greatest factor is the care and vigilance exercised in the merchandising of this line. Retail outlets with the largest volume of sales uniformly exhibit a low damaged goods rate because of rapid turnover and skill in handling."

"Our losses due to shrinkage, spoilage, and general deterioration vary considerably, depending on the season of the year and the personnel. Numerous tests that we have made on our produce line as a whole indicated that during the cooler weather the shrinkage on produce is about 5-7% and during the warm weather this is stepped up to about 10%."

The U. S. Bureau of Agricultural Economics, in a study of price spreads between the farmer and the consumer (Been and Waugh), makes no allowance for the shrinkage of fresh fruits and vegetables, assuming that there is no loss or waste between the farmer and the consumer. They suggest, however, that to sell 100 pounds of onions at retail, it might be necessary for the farmer to supply 110 pounds—as 10 pounds might be lost through culling, spoilage, and shrinkage, and go on to say that shrinkage on these items (fresh fruits and vegetables) varies through the months of the year, and that little information on the subject is available.

The U. S. Department of Commerce, in the report of the Louisville (Kentucky) Grocery Survey, in which 26 stores were studied from December, 1928, to May, 1929, made deductions from the gross sales of each store to cover spoilage and loss in trimming fresh fruits and vegetables. The amounts involved in this deduction ranged from less than 1 percent to more than 2½ percent of sales, an average of something less than 1½ percent. At the time of this survey there were no peaches in the market, and strawberries made up only 1.1

percent of the total fresh-fruit and -vegetable sales; there was no green corn, practically no asparagus, and peas amounted to but .4 percent of the total.

The Federal Trade Commission, in reporting their Agricultural Income Inquiry (1937), did not determine the retail losses of the fruits and vegetables which are of major interest to the quick-freezing industry. In a study of peaches made in the early part of September, 1936, they divided the loss of retail value as "spoilage loss" .18 percent and "damaged and reduced to sell loss" 6.28 percent, a total retail value loss of 6.46 percent. At the same time the total tomato loss was almost exactly twice that of peaches—13.09 percent. The FTC reported that a chain-store company had found, over a period of 2 years, that their average peach loss amounted to 24.25 percent with a range from 15 to 30 percent.

TRANSPORTATION LOSSES

The transportation of fresh fruits and vegetables from the producing area to the market involves risk of loss or damage from several causes—freezing, over-heating, bruising, improper containers and faulty packing, improper loading, lack of ventilation, and delays in transit and in loading and unloading.

No records have been located which give any indication of the extent of loss and damage during transportation by motor truck. The systematic recording of such information would be complicated by the fact that a large part of the produce transported by motor truck is the property of the carrier. Truckers who are not common carriers probably never will make public reports of their losses. If loss and damage claims become a serious matter for the common-carrier truckers, they undoubtedly will keep records and endeavor to find means to prevent such losses, as the railroads have done.

The above FTC report says that the loss and damage claims paid by the railroads on shipments of fresh fruits and vegetables during 1935 were equivalent to less than 1 percent of the farmer's cash income from all fresh fruits and vegetables, and about 2.6 percent of the freight charges on such shipments. During the 5-year period ending 1936 the railroads paid claims on fresh fruits, melons, and vegetables amounting to almost 30 million dollars, or approximately one-third of the total claims on all commodities. During 1935 the average amount of loss and damage claims per car handled was $6.83; fruits other than citrus, $6.20; melons, $16.60; fresh vegetables, $6.73.

Losses vary with different varieties of produce. The following is a partial list for the year 1935 as compiled by the Association of American Railroads, giving the average loss on carlot shipments per

car on all cars handled:

Asparagus	$13.27
Plums and prunes	16.98
Strawberries	11.13
Apples	5.85
Spinach	8.90
Mixed vegetables	7.97
Peaches	8.98
Cauliflower	12.39
Grapes	12.48
Carrots	16.06
Tomatoes	18.47

Of the nearly 5½ million dollars paid in claims in 1935, the Association was unable to determine the causes of damage in cases amounting to 53.1 percent of the total. Causes determined were:

	Percent
Rough handling of cars	22.5
Freezing or heating failure	9.8
Delay	5.8
Improper refrigeration or ventilation	3.3
Errors of employees	1.7
Wreck	1.2
Defective equipment	1.0
Unlocated loss	.7
Robbery	.5
Improper handling, loading, or stowing	.3

OTHER LOSSES

Another large loss in connection with the consumption of fresh fruits and vegetables cannot be estimated; that is, the loss in kitchen preparation. Unscrupulous selling or careless buying may run the loss up to large proportions. A housewife recently was heard to complain that she had bought strawberries of fine appearance but when she prepared them for the table she had to throw out over half of them. There are unnoticed bruises and other defects in peaches and apples; brown centers in good-looking strawberries, due to weather conditions at ripening time; uneven maturing of peas; and clever "top-dressing" and repacking to contend with, besides general deterioration from overlong storage.

PART II—PRODUCTION FOR FREEZING

ESTABLISHING FREEZING OPERATIONS

In establishing fruit and vegetable freezing operations in any particular area, certain primary factors relative to the raw materials available for processing must be taken into account. First, can a reliable supply of high-quality products suitable for freezing be grown in the area, so that the packing plant can be kept running continuously through a sufficiently long season to justify the plant investment? Second, are local production and marketing conditions such that growers will be content with returns comparable to those received in competing areas? On the answers to these questions may depend the ability to compete with plants in other localities.

The second question applies to all fresh-market-production areas, but more directly to the early fresh-production sections, where growers usually prefer to take a chance on the fresh market, hoping for an occasional high-priced season to balance the more frequent low-priced years, rather than contract their produce to processors at predetermined prices insuring a moderate profit. In many instances, farms are too small, production costs too high, or yields too low to provide sufficient cash income at prices which are profitable to growers in other areas and which the processor can pay. If the grower does contract to supply the processor, will he resist the temptation to divert his products to the fresh market when prices are high, or, dissatisfied with his returns, transfer his agricultural operations to other and more profitable lines, leaving the processor without raw materials for his plant? These are old problems for the food processor and are mainly responsible for the small amount of processing done in the Southeast.

Looking at it from the growers' standpoint, will consumers be willing to pay high prices for early fresh produce when the distribution of frozen "fresh" products has been extended and they are generally available at standardized prices the year round? Apart from the question of actual replacement of early fresh-market products by frozen, there seems no doubt that frozen products will have a leveling effect on prices, which is bound to affect the early-produce grower. It may be to his advantage to have a steady, reliable processing market available for a part, at least, of his production. This consideration cannot be expected to appeal to an outside packer, but farm cooperatives and local business men may find it a deciding factor in establishing freezing operations.

The processing operations in the early southeastern states depend for the most part on produce too ripe for shipment, week-end harvests, or surplus low-priced produce when the fresh market is overloaded. The Florida and Louisiana strawberry-freezing plants operate on this basis. Not only do these processing operations take products which otherwise would represent either a complete loss or less than cost-of-production prices in the fresh market, but they form a backlog below which fresh-market prices cannot fall.

Drawing definite conclusions regarding the best growing areas for fruits and vegetables for quick-freezing, on which comparisons might be based as to quality, yields, and cost of production, is exceedingly difficult. Little unbiased information could be located on the subject of the comparative quality of products grown in various sections of the country. The northwestern growers and packers claim the finest products in the world, and profess the belief that the East cannot compete with them on a quality basis. New Jersey and the Eastern Shore of Maryland and Virginia lay claim to the best lima beans. Distributors of frozen foods in Florida have said that Florida products could not be frozen satisfactorily because they "are too full of water." Florida and Louisiana strawberries have been criticised as "soft and tasteless, on account of the use of too much nitrogen." Opinions to the effect that the farther north you go the better-flavored fruits and vegetables you get are frequently expressed—and not always in the North. Irrigation districts have been accused of producing products lacking in flavor, because of excessive use of water in order to attain high yields and fine appearance. The Rocky Mountain States ask why they should buy frozen peas from other sections when they grow "the best in the world." Maine also has its boosters when quality peas are considered.

These are a few illustrations of the interesting if not necessarily conclusive opinions encountered in the course of interviews with men connected with the food industry, who would be expected to know the comparative characteristics of the products grown in their own territory. Obviously these opinions are colored by sectional loyalty or prejudice. Perhaps too little attention is paid to the possibilities of scientific plant breeding and soil treatment in adapting varieties with desirable freezing characteristics to soils and climatic conditions in sections otherwise well located for quick-freezing operations.

VARIETIES OF FRUITS AND VEGETABLES FOR FREEZING

In the selection of varieties of fruits and vegetables to be planted for preservation by freezing, quality is of first importance. Quality requirements for freezing differ materially from canners' specifications, and are even more stringent. Nothing in the preparation and freezing operations can add to the original quality of the product and, practically without exception, none of the operations tend to equalize an unevenly matured or irregularly shaped, colored, or flavored product.

The determination of the varieties which can be grown to advantage in the area and which are suitable for freezing is therefore of primary importance. The characteristics developed for long-distance shipping and keeping qualities, or for the canner, may not only be unnecessary but may be undesirable for frozen pack. Broadly speaking, the home-garden varieties which have been found of finest flavor, color, and texture, when prepared and served fresh from the garden, are usually best for freezing—if yield and maturity characteristics are satisfactory.

Uniformity is a requisite so that the consumer can depend on the trade-mark or packer's name for a certain type or quality and know what to expect when he reorders.

In the production of raw materials for freezing, the grower and the processor follow, in general, the practices of the canning industry rather than the fresh market. Varieties of vegetables such as peas and lima beans, should be selected for even maturity and for machine harvesting. Under local conditions of soil, climate, and growing methods, the varieties selected must produce large enough yields per acre to insure adequate returns to the grower at prices which the processor can pay in competition with other processing areas.

The varieties must also be acceptable in the markets for which the products are packed. The Northeast, for instance, prefers its green beans young and tender, while parts of the South and Midwest like a more mature pod with well-developed beans. Not only should sectional prejudices be taken into account, but also consumer requirements, especially in the case of fruits. That is, preserve and pie fruits should be packed for the preserver and the pie baker, and the sweeter dessert fruits for institutional and retail distribution.

In considering approved varieties, it is advisable to consider the localities in which they were grown when the freezing tests were made. Soil, climatic conditions, and the fertilizer and water supplies, are all factors affecting the product. The importance of selecting proper varieties with respect to geographical origin is evidenced by the amount of independent experimental work which has been done in the localities where the more extensive freezing operations are being

carried on. More and more we see the production region coupled with the variety; and one large distributor is making a point of mentioning the different states in which its products are packed. Purchasers are reporting that the same item packed in different localities may vary so much in quality that they find it advisable to specify the production locality when placing orders.

The possibilities of improving local varieties, adapting foreign varieties, or developing new ones, as well as improving fertilization methods, should not be overlooked. The experiment stations of many agricultural states are working along these lines. The Tennessee Station, for example, has recently developed a high-quality, disease-resistant red raspberry, Tennessee Autumn, which can be grown successfully in the southern states.

FRUIT VARIETIES

Strawberry

Marshall strawberry is used almost exclusively for the important cold-pack operations in Oregon, Washington, and Utah. Missionary is packed from Florida northward along the East Coast. Missionary, Blakemore, and Klondike are packed in Alabama. Louisiana is the heavy packing field for Klondike, which also is packed in Tennessee, although here the Blakemore predominates. The 1937 Michigan pack, of about 6,000 barrels, was reported to be 75 percent Premier, followed by Dunlap and Gibson. In New York State, Gibson and Premier led.

The 1935 market survey located 63,620 barrels of Marshall grown in the Northwest; 16,895 barrels of Missionary originating in the Middle Atlantic States—North Carolina, Virginia, and Maryland; 3,833 barrels of Klondike, mainly from Louisiana and western Tennessee; and 2,146 barrels of Blakemore, packed in the same general localities as Missionary.

The predominance of Marshall was obvious, especially in the preserve industry. Many processors asserted that it was the only cold-pack berry they had found suitable for their work, and that they would consider no other. Others were less positive, and a few expressed a preference for Klondike, Missionary, or Blakemore, provided a good pack of these eastern berries could be obtained.

As a matter of fact, Missionary was being used satisfactorily for preserves in Pittsburgh, Rochester, Boston, and New York City, and for ice cream in Boston, Philadelphia, and Baltimore. Baltimore preservers, located in one of the largest Missionary-packing centers, used Marshall exclusively; while Baltimore ice-cream manufacturers used only Missionary. In Philadelphia, another important Missionary

packing center, the Missionary had made little impression on the preserving trade, but dominated the ice-cream industry.

Klondike was used for preserves mainly in St. Louis and Cincinnati, but to some extent in New York and Boston. Its geographical origin may be responsible in part for this distribution. Packed in barrels, Klondike was used in ice cream, mainly in Boston. Crate-frozen for pies, it seemed to predominate in Chicago.

Blakemore made a good showing in the preserve industry in Pittsburgh, and to a small extent was used in Cincinnati, western New York, and Boston. Practically its only extensive use in ice cream was in Boston.

Based on opinions expressed during the market survey, the following composite specifications describe the ideal strawberry for preserving: Firm, of good flavor, of bright-red color, colored throughout with no white sections, of high acid content so that it will jell more easily and require less cooking to evaporate the necessary amount of moisture and therefore give a higher yield of preserves per barrel of fruit. Berries to be closely graded, ⅝-⅞ inch in size (measured across the widest part); to be uniformly ripened; clean; and packed in an accurately proportioned amount of sugar.

Pie bakers prefer a medium-sized berry, of bright color, high acid content, and good flavor, which will not disintegrate when baked.

Blakemore has not been as well established in the institutional trade as Marshall and Missionary, which were accepted from the start. Good reports have been received, however, on the University of Tennessee experimental pack of single-frozen Blakemore.

The institutional and retail trades eventually may require a berry of different characteristics from those acceptable to the preserve trade. As a large proportion of the fruits frozen for home and institutional consumption is not cooked but used as fresh dessert fruit, it is probable that the trend will be more toward the sweet dessert-type berry. Premier and Dorsett have been well spoken of.

Blakemore as produced in Tennessee should be recognized as probably the best strawberry for the preserve industry. It has the proper size and shape, a bright-red uniform color throughout, is relatively high in acidity, and has the prominent bright-yellow seeds now preferred by many preservers.

A large midwestern preserver ran a comparative commercial production test, using Marshall, Klondike, and Blakemore. The Blakemore was frozen by the University of Tennessee Engineering Experiment Station in cooperation with the Tennessee Valley Authority, by the frozen-pack methods commonly used in other localities. The samples of preserves sent to the Agricultural Experiment Station

for examination left no doubt as to the superiority of Blakemore when used according to that manufacturer's processing method. Scrutiny of the Marshall and Klondike jars did not reveal any whole berries, and when the jars were opened the contents resembled jam more than preserves. On the other hand, a large percentage of the Blakemore berries had retained their shape. They were of good color, appearance, and flavor.

A New York preserver who had been using Klondike said it worked fairly well if used within six months after packing. After that it went to pieces badly. He stated that Blakemore held its shape well and a few Blakemores mixed with Klondike or Marshall noticeably improved the jar of preserves.

The ice-cream manufacturers prefer a berry of rich color and high flavor, with subacid flesh. They differ from the preserver in wanting richer color and less acid, and in their willingness to accept larger berries because the fruit is thoroughly pulped in the ice-cream mix. They also like a berry which does not freeze extremely hard.

Other Fruits

The 1935 survey found that the leading varieties of fruits, other than strawberries, frozen for the processors' market, were Cuthbert red raspberry; Evergreen blackberry; Montmorency cherry; Elberta, Hale, and Georgia Belle peaches. The wild blackberry grown in eastern Kentucky was being frozen for processing into jam and jelly. The fine-quality eastern Tennessee wild blackberry should be acceptable in this market. The low-bush wild blueberry from Newfoundland and Maine was preferred by the pie trade over the cultivated varieties. It should be possible to develop a cultivated blueberry for this trade.

Frozen apple slices are packed for the pie trade, and only good pie apples should be frozen for this market. Various authorities have mentioned Baldwin, Winesap, Northern Spy, Stark, Jonathan, Spitzenberg, Rome Beauty, and Rhode Island Greening.

Since no work of record has been done on variety freezing tests in Tennessee, information on fruits other than strawberries has been taken from other sources, and it should be remembered that the varieties tested may not give the same results when grown in Tennessee.

The following lists give fruit varieties which have been frozen successfully in various regional tests or commercial freezing operations, and which usually grow well in Tennessee:

Apples
- Golden Delicious
- Grimes
- Jonathan
- Rome Beauty
- Stayman
- Winesap

Blackberries
- Early Harvest
- Eldorado
- Common wild

Cherries
- Early Richmond
- Montmorency
- (Under favorable conditions sweet varieties are successfully grown in Tennessee)

Dewberries
- Boysenberries
- Youngberries
- Common wild

Figs
- Brown Turkey
- Celestial

Gooseberries
- Glendale

Grapes
- Concord
- Fredonia
- Thomas

Peaches
- Crawford
- Early Elberta
- Eclipse
- Elberta
- Georgia Belle
- Halehaven
- Hiley
- J. H. Hale
- Oriole
- Primrose
- South Haven

Plums
- Damson
- Gold
- Methley
- Wild Goose

Raspberries (black)
- Cumberland

Raspberries (red)
- Chief
- Latham
- St. Regis
- (Cuthbert is the most popular variety for freezing, but is rarely grown successfully in Tennessee)

Strawberries
- Blakemore
- Dorsett
- Klondike
- Missionary
- Premier
- (Tennessee Blakemore and Klondike have proved satisfactory for commercial freezing, the Blakemore being especially liked for preserves. Aroma is not suited to freezing)

VEGETABLE VARIETIES

Seed supply houses list vegetable varieties acceptable for commercial freezing, and these lists probably are the best sources of information, unless local freezing tests have been made. Extensive tests of local products have been made in the Northwest by the U. S. Frozen Pack Laboratory, in cooperation with the Washington State Agricultural Experiment Station; in western New York by the New York State Agricultural Experiment Station; and in other sections of the country by state agricultural experiment stations.

From these various lists of vegetables found suitable for freezing, the following have been selected which usually can be grown satisfactorily in Tennessee:

Asparagus
- Martha Washington
- Mary Washington

Beans (lima)
- Burpee Improved
- Fordhook
- Henderson Bush
- King of the Garden

Beans (snap)
- Early Refugee Stringless
- Full Measure
- Kentucky Wonder
- Mosaic Resistant Refugee
- McCaslan
- Stringless Green Pod
- Stringless Valentine

Carrots
- Chantenay
- Nantes

Cauliflower
- Snowball

Corn
- Country Gentleman
- Golden Bantam
- Hybrids of Golden Bantam
- Stowell Evergreen

Peas
- Gradus
- Laxtonian
- Laxton Progress
- Thomas Laxton
- (Alaska is not frozen commercially)

Spinach
- Bloomsdale Savoy
- King of Denmark

Squash
- Boston Morrow

While broccoli and brussels sprouts are not grown to any great extent in Tennessee the following varieties are suggested for trial:

Broccoli
- Italian Green Sprouting (Calabrese)

Brussels sprouts
- Half Dwarf Improved
- Long Island Improved

PRESENT FROZEN-FOOD PACKING AREAS

The early-packing areas of quick-frozen fruits naturally tended to coincide with the localities in which the first food-freezing operations had been established; that is, where fruits were being cold-packed for processors, or where meats, fish, and poultry were being frozen for storage and transportation. The quick-freezing of vegetables started and has been carried on in close association with vegetable-canning operations, and now is being done mainly in vegetable-canning areas—in some instances in sections which produce for both the fresh market and canning.

Five maps, figures 7, 8, 9, 10, and 11, locate the major packing areas of the five classes of quick-frozen foods—fruits, vegetables, poultry, seafoods, and meats. At these locations, products prepared for cooking or serving are being frozen and packaged for distribution through quick-frozen-food channels, or, at least, products which are suitable for such distribution. Much of the cellulose-wrapped, eviscerated poultry and the wrapped fish fillets packed in these locations, are actually thawed before reaching the consumer and sold as fresh products. Delivery of many of these products to the consumer in frozen form merely awaits a wider distribution of low-temperature retail cabinets.

A fairly complete picture of the division of frozen-fruit and -vegetable packs among the areas can be obtained from tables 1 and 2.

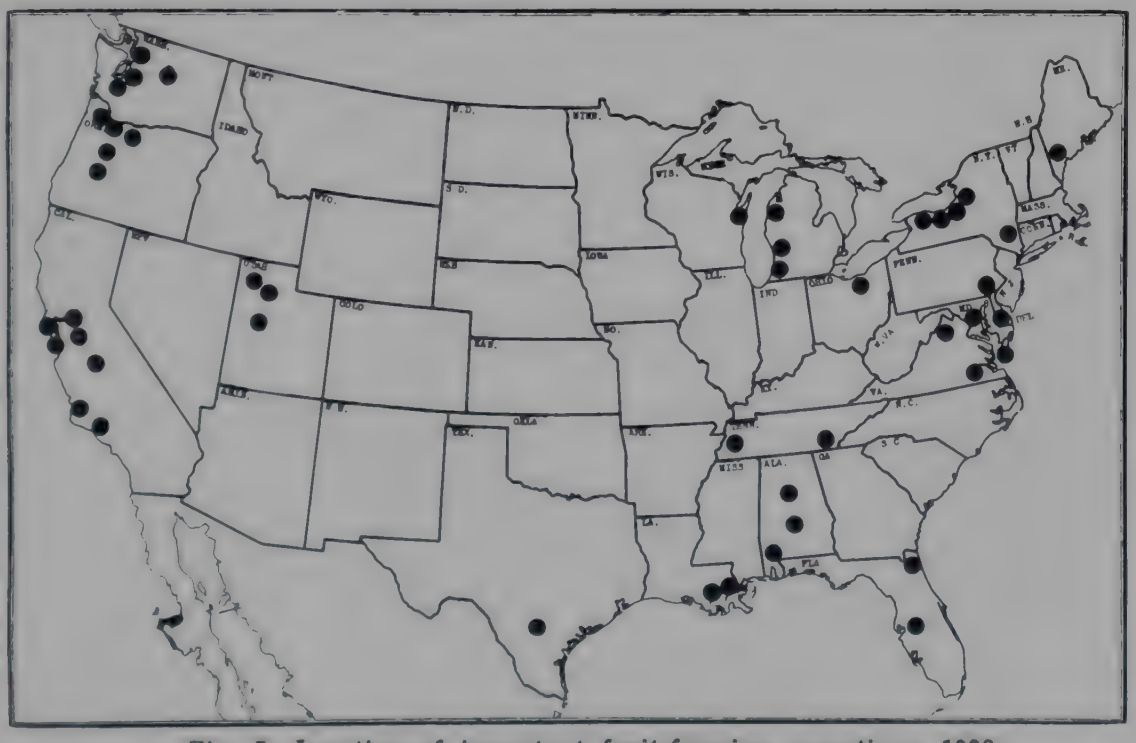

Fig. 7—Location of important fruit-freezing operations, 1938.

Fig. 8—Location of important vegetable-freezing operations, 1938.

Fig. 9—Location of important ready-to-cook poultry-freezing operations, 1938.

Fig. 10—Location of important packaged seafood-freezing operations, 1938.

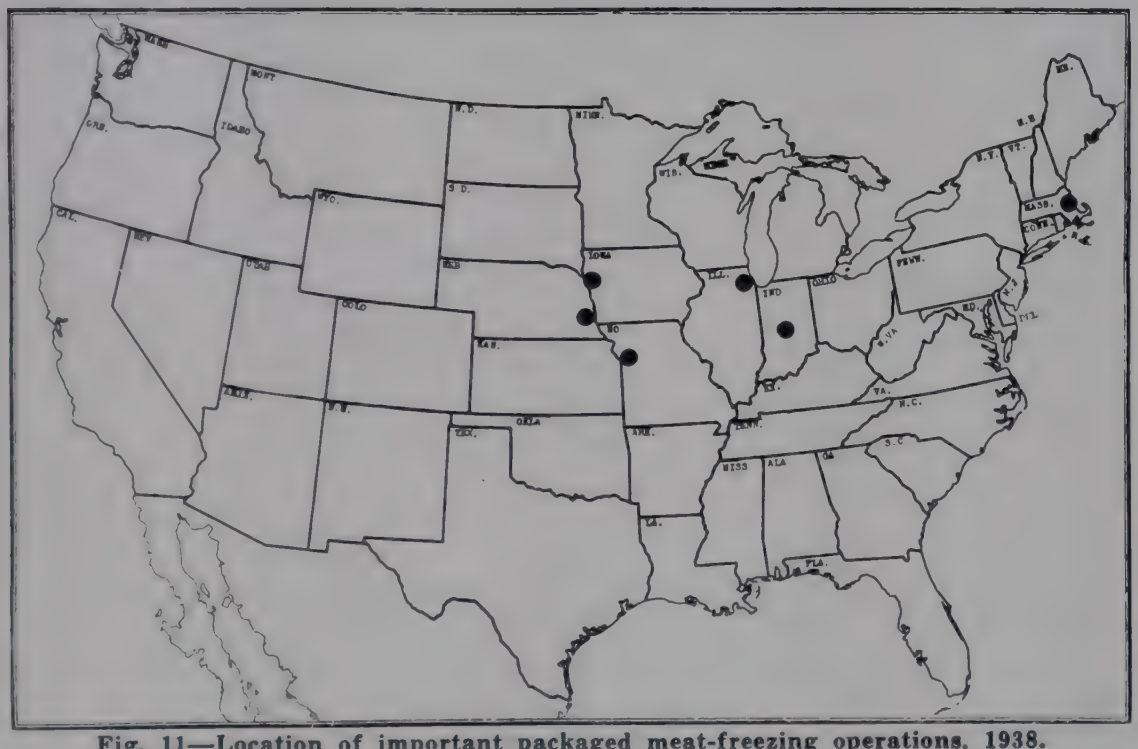

Fig. 11—Location of important packaged meat-freezing operations, 1938.

FRUITS

Fruit map, figure 7, shows that the major strawberry-packing areas are in Oregon, Washington, southern Louisiana, central Florida, and the Chesapeake Bay region. Alabama, Tennessee, Michigan, New York, and Maine, however, are increasing their strawberry packs.

Philadelphia packers draw from surrounding strawberry-growing areas in Pennsylvania and also pack fruit shipped in from both north and south. Norfolk operations are supplied from Virginia and North Carolina.

Oregon and Washington account for about 80 percent of the red-raspberry pack, with Michigan and New York packing the greater part of the remainder.

The bulk of the peach pack appears to center in Philadelphia. There are no statistics available on the total peach pack, but one Philadelphia packer is reported to have packed 2,250,000 pounds in 1937, while Oregon and Washington packed approximately 800,000 pounds. The northwestern peach pack, however, is increasing rapidly, the 1937 pack being more than four times the 1936 pack.

New York is well in the lead in packing red sour cherries, accounting for approximately two-thirds of the total, followed by Michigan, Wisconsin, Ohio, and Pennsylvania. Oregon and Washington pack only about 10 percent of the total, but are rapidly increasing their output.

The large Youngberry and Boysenberry packs and the citrus-juice packs are mostly concentrated in the Los Angeles area. Nearly all of the cultivated blackberry pack comes from Oregon and Washington.

Approximately one-half of the frozen apple slices are packed in northern Virginia, followed by Michigan, New York, and Pennsylvania.

We are importing nearly all of our frozen blueberries from Newfoundland and Nova Scotia, but our domestic pack is increasing, mainly in the Northwest, Pennsylvania, Michigan, and Maine.

VEGETABLES

The quick-frozen vegetable pack, figure 8, comes, for the most part, from four major areas—the Pacific Northwest, southern New Jersey, western New York, and Maine. The lower Rio Grande Valley of Texas supplies a considerable midwinter pack of the more popular vegetables; California is increasing its vegetable-freezing operations; and northern Utah started packing in 1938, as did Indiana. Southern Minnesota is increasing the commercial pack started in 1937.

The East, in 1937, packed slightly more than one-half of the peas and about 97 percent of the lima beans. These are the two most popular vegetables and accounted for over 60 percent of the total vegetable pack. The East also accounted for nearly 70 percent of the heavy green and waxed-bean pack and over 80 percent of an al-

most equal asparagus pack. Over 70 percent of the total frozen vegetables were packed in the East, according to available 1937 records.

POULTRY

Eviscerated, packaged poultry is frozen in Omaha, in several localities in Iowa, and in Fort Wayne, as shown in figure 9. New York City and Long Island lead in the freezing of ducks, while most of the squabs are packed in California. Northern Utah specializes in the freezing of turkeys.

SEAFOODS

The freezing of fish and other seafoods is concentrated at the heavy fishing centers on the eastern and western seacoasts, the Great Lakes, and the Gulf of Mexico, as indicated in figure 10.

MEATS

Figure 11 shows concentration of frozen-packaged meat packing at Sioux City, Omaha, Kansas City, Chicago, and Indianapolis. This was to be expected, since the large meat-packing plants are located in these cities.

PACKING SEASONS

From an economic standpoint it is important that the investment in packing equipment be in use through as long a period each year as possible, in order to keep the investment overhead charges at a minimum, and to give labor as long unbroken employment as possible.

Approximate comparisons may be made of the lengths of packing seasons in the more important fruit- and vegetable-freezing sections, by reference to figures 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, and 22, covering the packing schedules in Virginia, New Jersey, New York, Maine, Tennessee, Indiana, Minnesota, Utah, California, Oregon, and the Northwest; figure 23, which is the season and production chart of a large northwestern packer; and figures 24, 25, 26, 27, and 28, covering the national packing seasons for strawberries, peas, lima beans, string beans, and corn—the fruits and vegetables most important to the quick-frozen-food industry.

The information on which these charts are based has been secured from various sources, including actual records of packers, as well as published information. The charts as a group show inconsistencies, but give a fairly accurate picture of present operations in important packing centers.

The possible packing periods within a state may vary considerably in both length and season, because of different climatic and soil conditions. If a particular state shows an unduly short packing period for any item, this does not necessarily mean that the period cannot be lengthened. In some of the state charts there are breaks in the packing period, indicating lengthy shut-downs. These breaks could be filled, in many instances, either by lengthening the producing season of the original products or by the introduction of other items.

It will be noted that production breaks occur mostly in states which have more recently begun frozen-vegetable operations, such as Virginia, Indiana, Minnesota, and Utah. On the other hand, the charts of states in which large-volume frozen-food packing has been longest established—Maine, New Jersey, New York, and Oregon—show continuous operation and overlapping of items throughout the entire packing season. Figure 23, covering the operations of a northwestern packer, shows only three minor breaks in production from April 15 to November 10—nearly seven months. Oregon chart, figure 21, indicates possible continuous operation for nearly nine months. California chart, figure 20, shows a possible 10-month period, and Tennessee chart, figure 16, slightly over six months.

In comparing the charts of New Jersey and Oregon, the two oldest and heaviest frozen-vegetable-packing states, we find unusually long and somewhat similar packing periods for the important items

—asparagus, string beans, lima beans, and broccoli. Both of these vegetable sections are near the seacoast, and climatic and soil conditions probably are well suited to long growing seasons, which may account for the growth of the industry; also, the long establishment of large frozen-food packing operations may have contributed to the extension of the growing season.

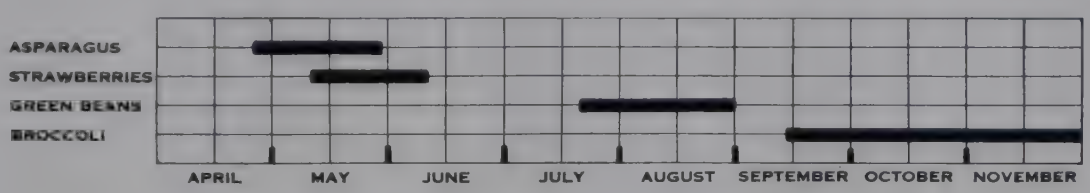

Fig. 12—Normal frozen-food packing seasons, Virginia.

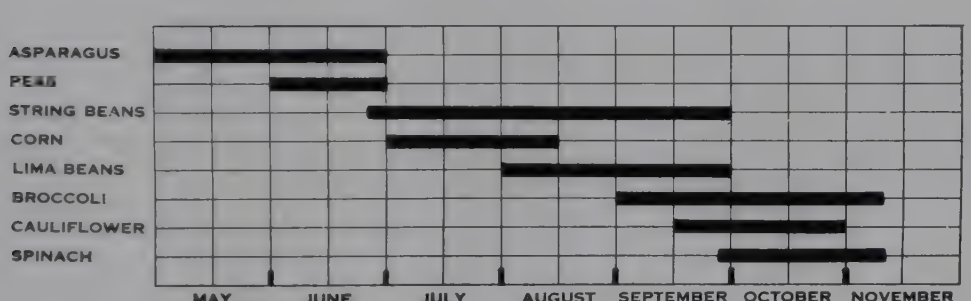

Fig. 13—Normal frozen-food packing seasons, southern New Jersey

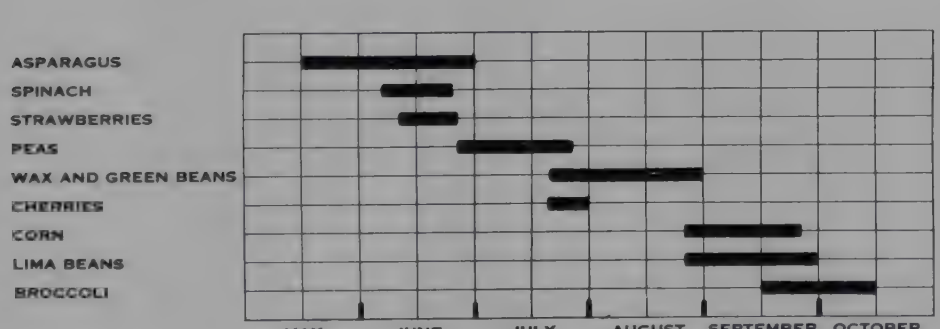

Fig. 14—Normal frozen-food packing seasons, western New York

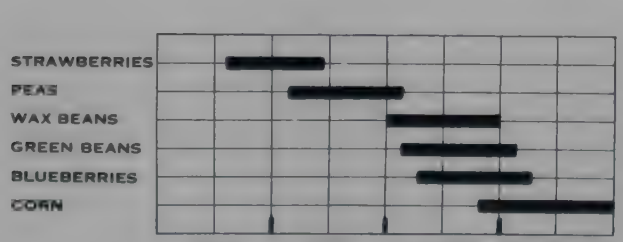

Fig. 15—Normal frozen-food packing seasons, Maine.

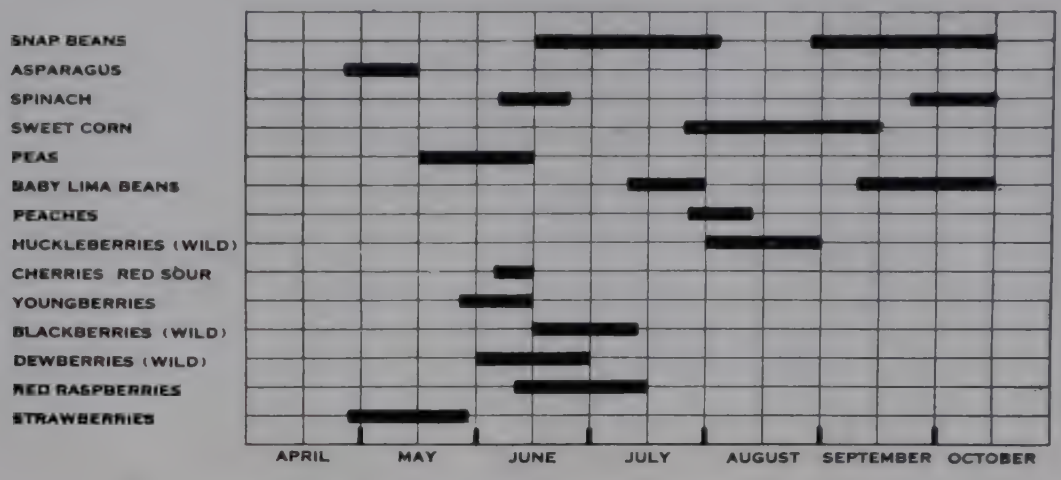

Fig. 16—Normal frozen-food packing seasons, East Tennessee

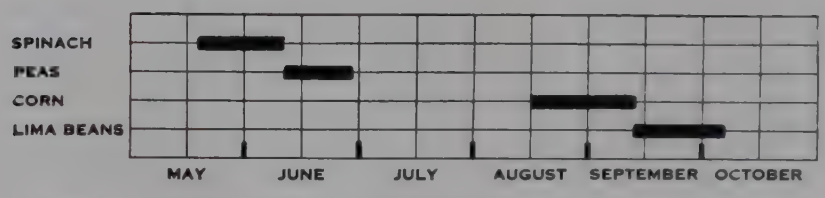

Fig. 17—Normal frozen-food packing seasons, Indiana

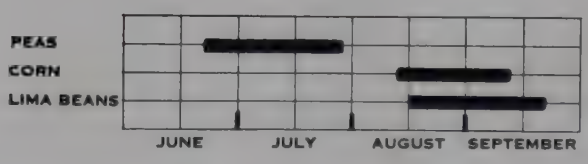

Fig. 18—Normal frozen-food packing seasons, Minnesota.

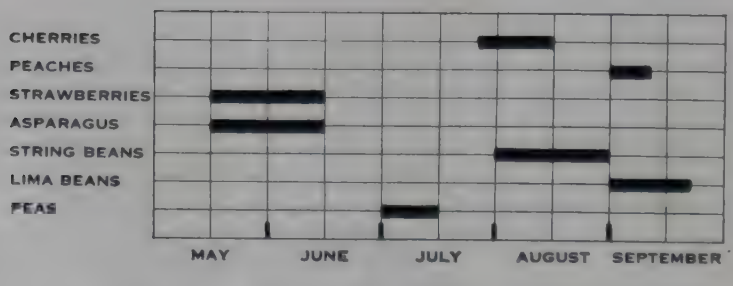

Fig. 19—Normal frozen-food packing seasons, Utah

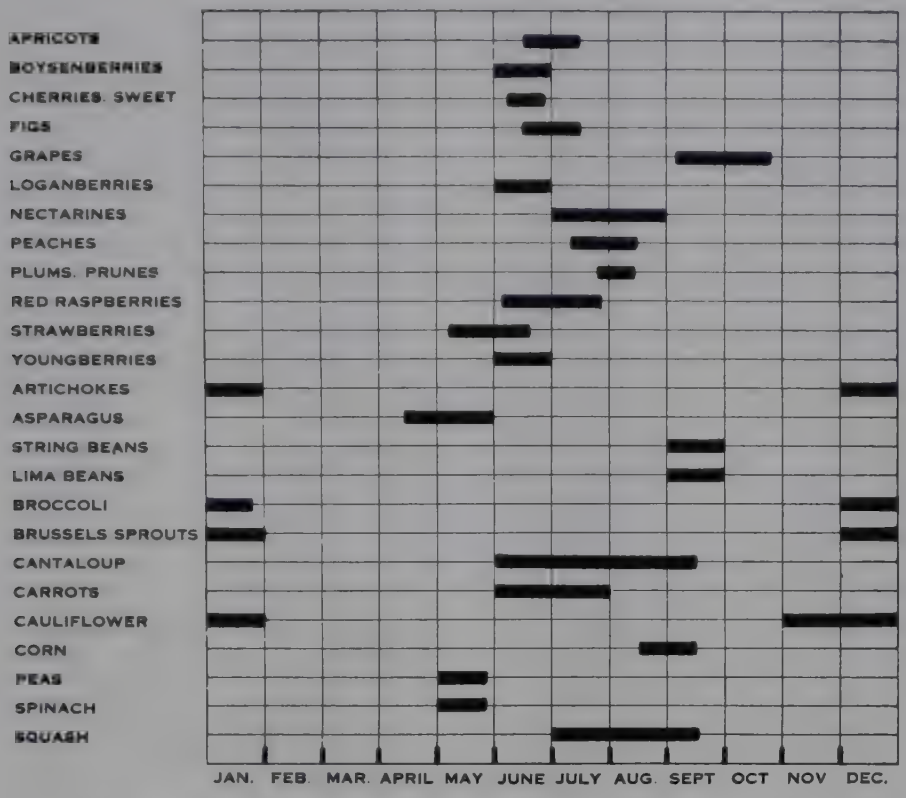

Fig. 20—Normal frozen-food packing seasons, California

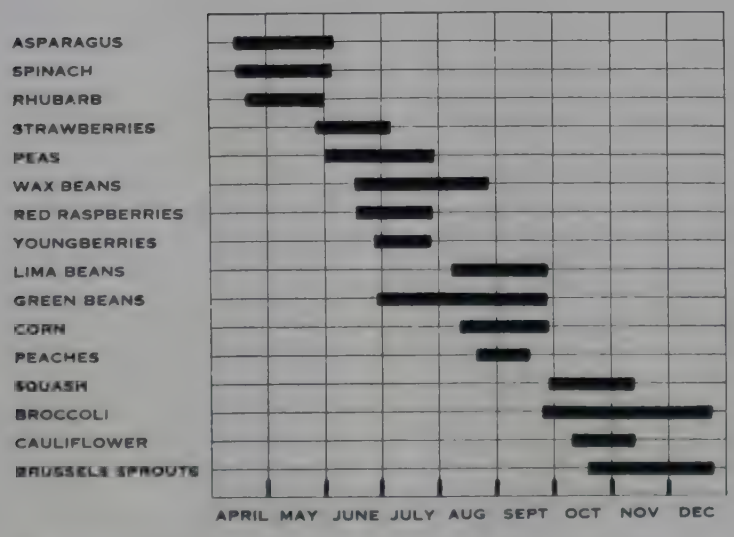

Fig. 21—Normal frozen-food packing seasons, Oregon.

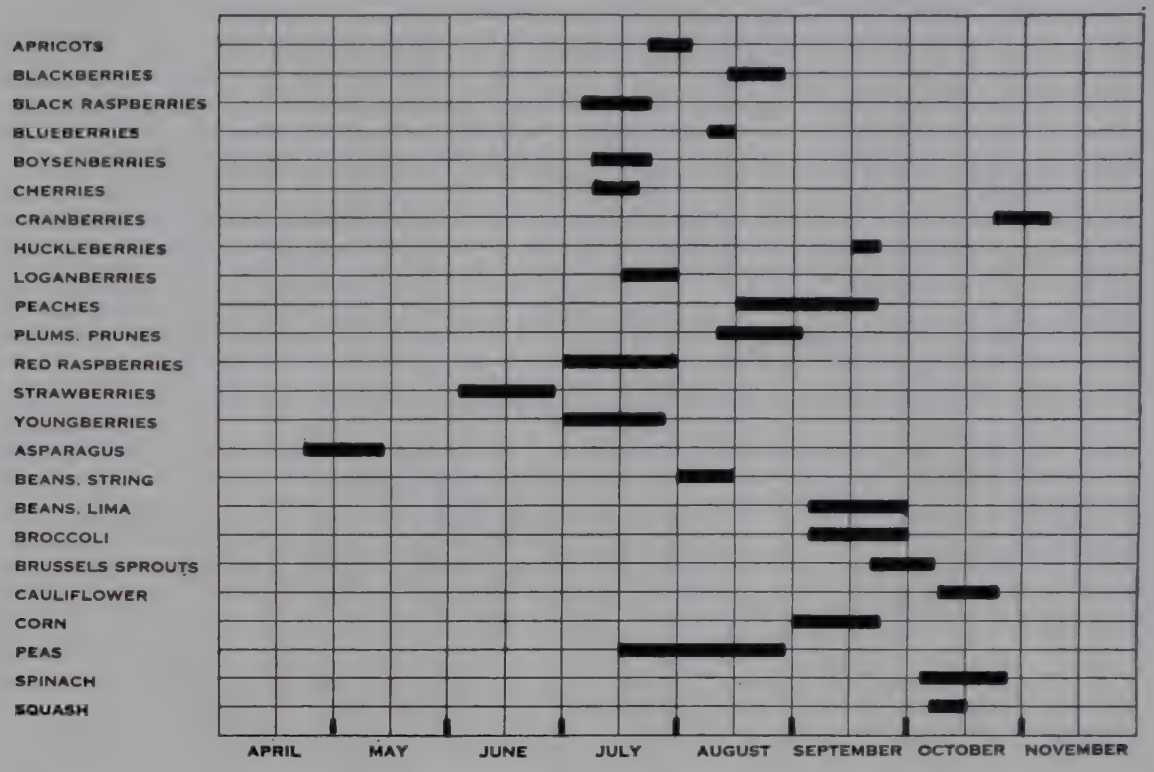

Fig. 22—Normal frozen-food packing seasons, Northwest.

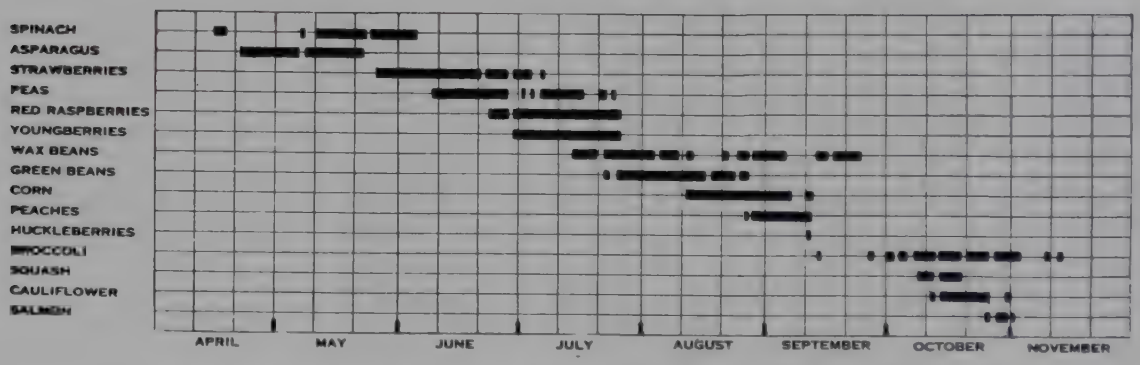

Fig. 23—Production chart of a northwestern frozen-food packer, 1936.

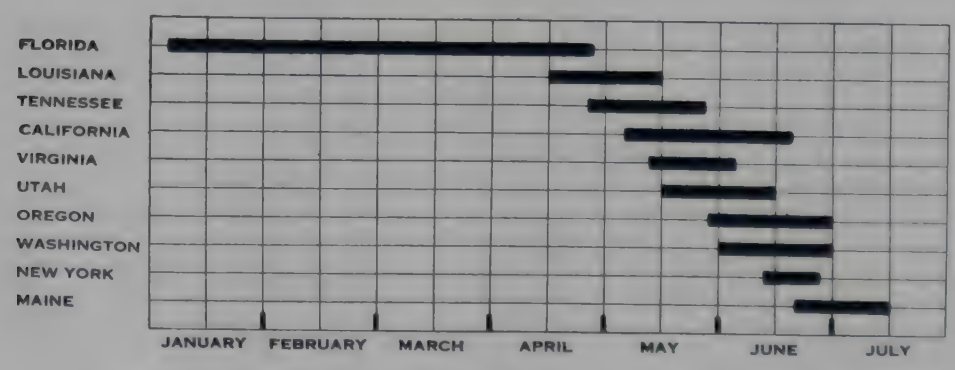

Fig. 24—Normal frozen-strawberry packing seasons.

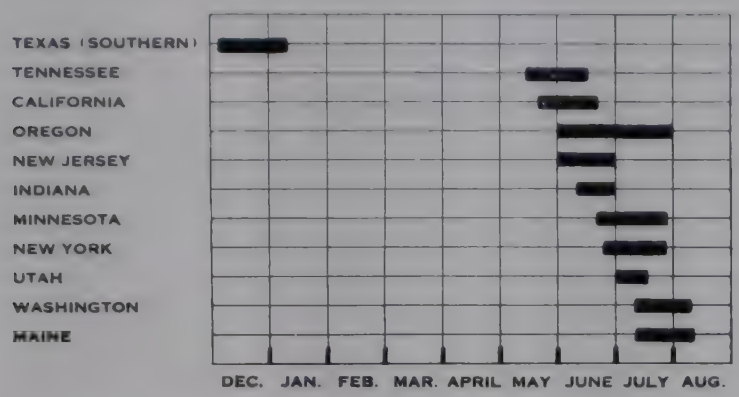

Fig. 25—Normal frozen-pea packing seasons.

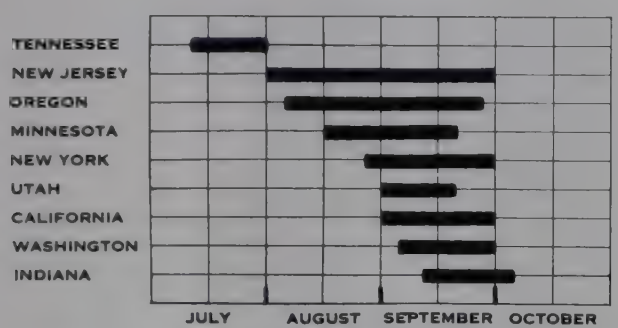

Fig. 26—Normal frozen-lima-bean packing seasons.

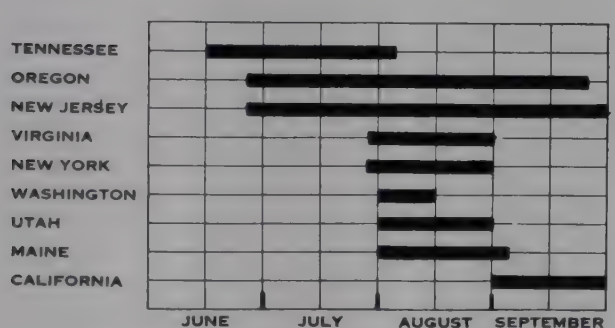

Fig. 27—Normal frozen-string-bean packing seasons.

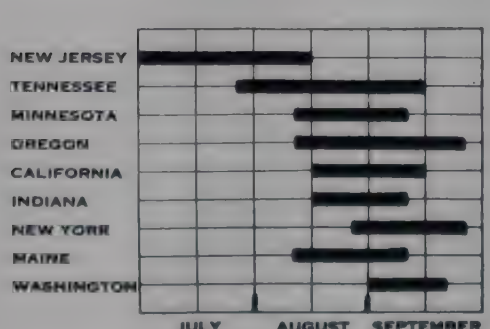

Fig. 28—Normal frozen-sweet-corn packing seasons.

It is interesting that these charts show that the large frozen-strawberry packs in the areas from Virginia to New York and west to Oregon and Washington are made within a period of only six weeks; that the bulk of the pea pack is made within eight weeks; lima beans, eight weeks; and sweet corn, six weeks; but the important Oregon and New Jersey string-bean packs cover about twelve weeks, although the string-bean packs in other states, with the exception of Tennessee, run from two to five weeks. Tennessee has an indicated string-bean packing season of seven weeks.

In the production and marketing of frozen-pack fruits and vegetables the seasons at which they mature and are packed is of little consequence except as they fit into the packer's schedule. So far as this "fresh" produce is concerned, growing areas may be selected on a cost and quality basis without regard to early or late production.

PRODUCTION OF FRUITS AND VEGETABLES WHICH ARE LEADERS IN THE QUICK-FROZEN-FOOD INDUSTRY

Figures 29, 30, 31, 32, 33, 34, 35, 36, 37, and 38 are based on the U. S. Department of Agriculture Crop Report, and show the national production, by states, of the fruits and vegetables now most popular for quick-freezing. These maps are intended to show the total production, regardless of the channels through which the produce is marketed. When information was available, separate maps were prepared showing vegetables produced for the fresh market and for the manufacturer.

The maps cover the 1938 production, with the exception of peaches. Because of the long-term plantings and the widely fluctuating crops in many sections, the 10-year average peach production, 1927-36, was used to give a more accurate production picture.

STRAWBERRY PRODUCTION

It is interesting that Oregon in 1938 (figure 29) with a production equivalent to 1,045,000 crates became, apparently for the first time, the second strawberry-producing state. Louisiana was first with a production of 1,100,000 crates, which it was reported included 99,000 crates not harvested. From the standpoint of used production, therefore, Oregon became the leading state. Oregon produces primarily for manufacture, as it is far from the major fresh markets. Louisiana, on the other hand, is an early state which, producing mainly for the

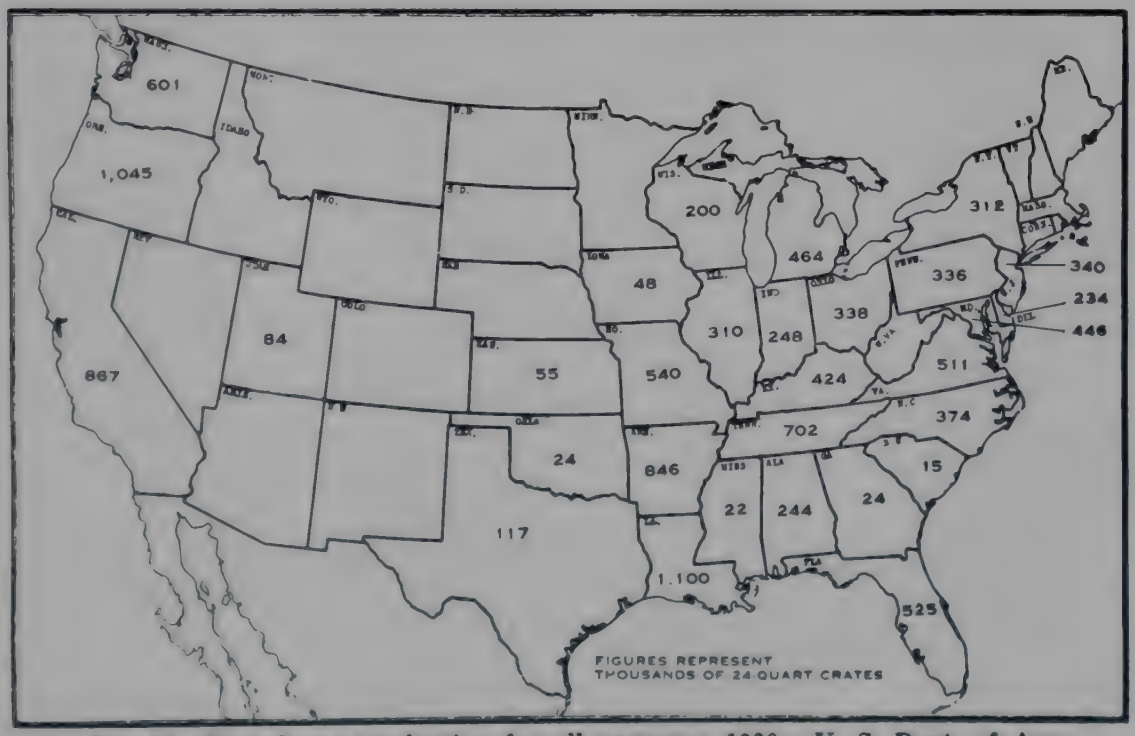

Fig. 29—Strawberry production for all purposes, 1938.—U. S. Dept. of Agr.

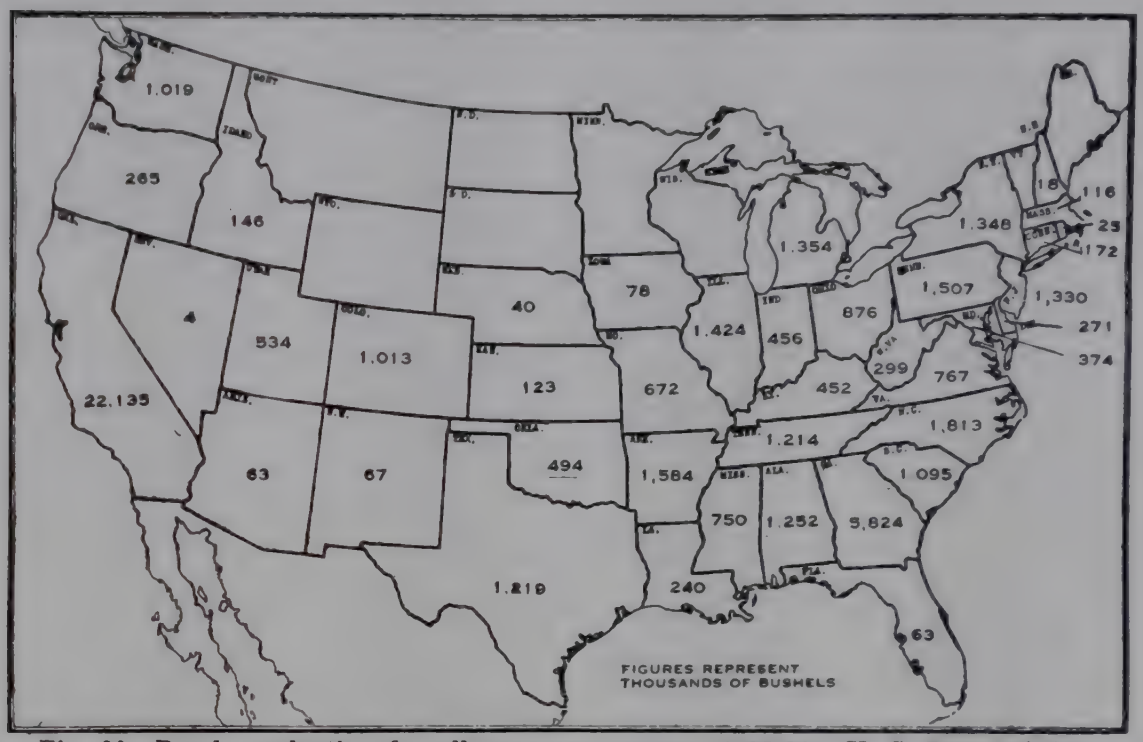

Fig. 30—Peach production for all purposes, average 1927-36.—U. S. Dept. of Agr.

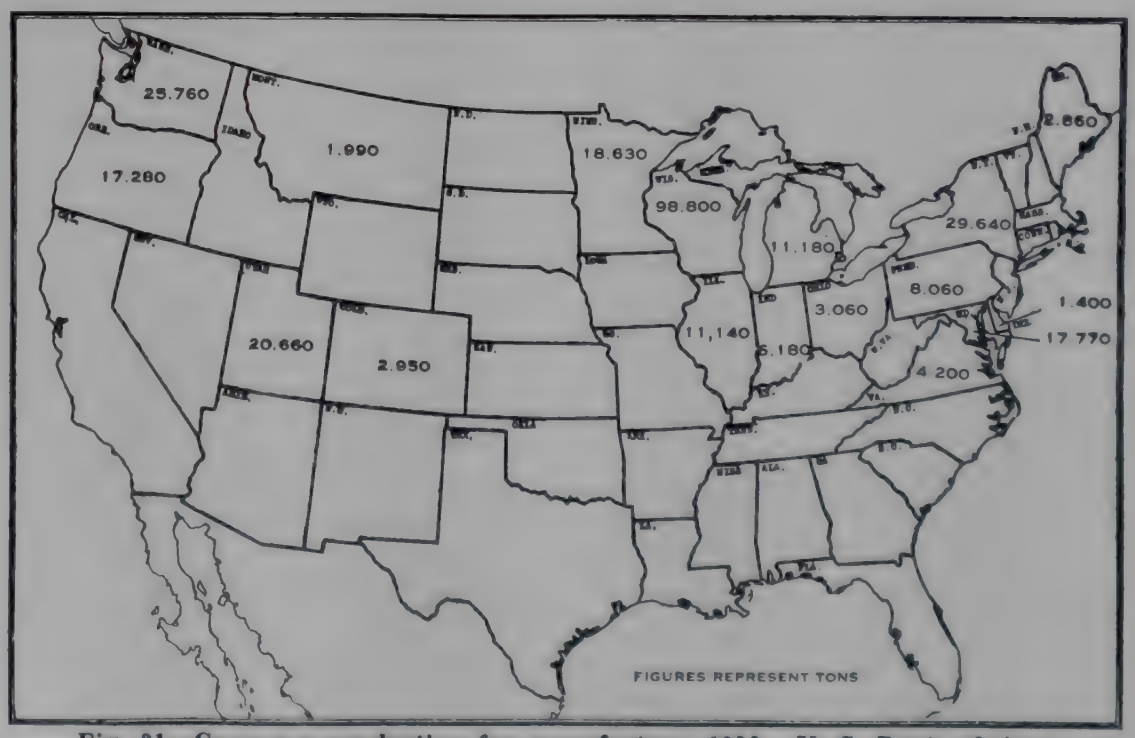

Fig. 31—Green-pea production for manufacture, 1938.—U. S. Dept. of Agr.

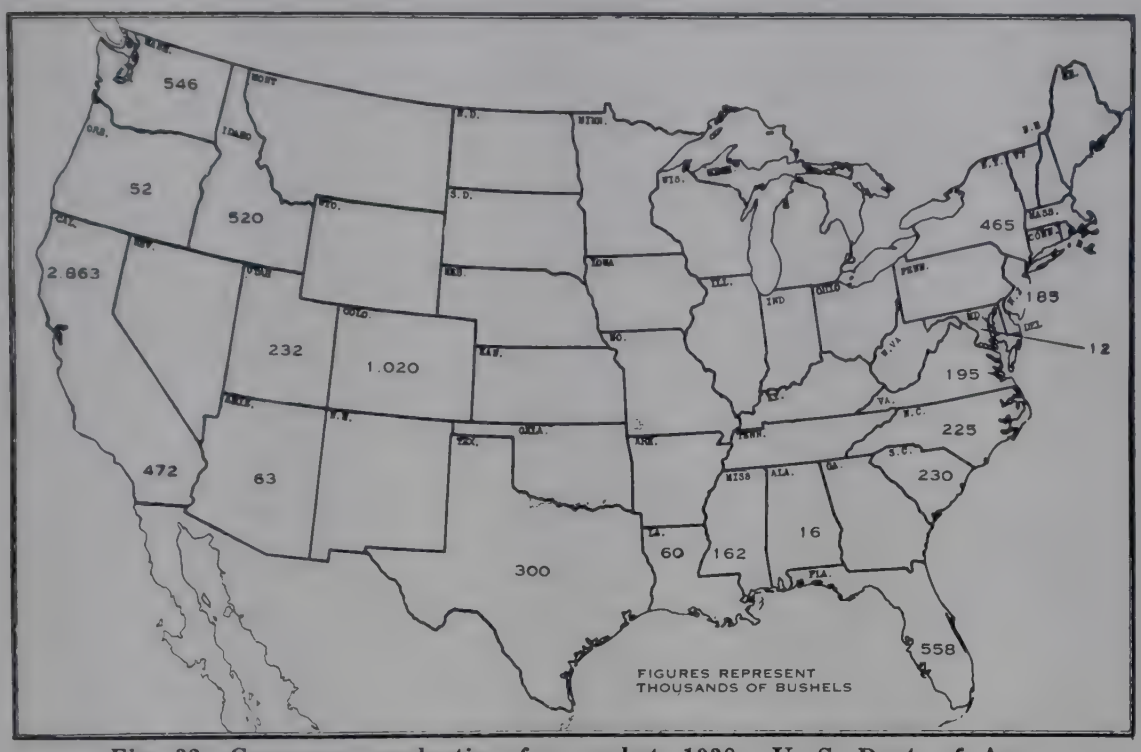

Fig. 32—Green-pea production for market, 1938.—U. S. Dept. of Agr.

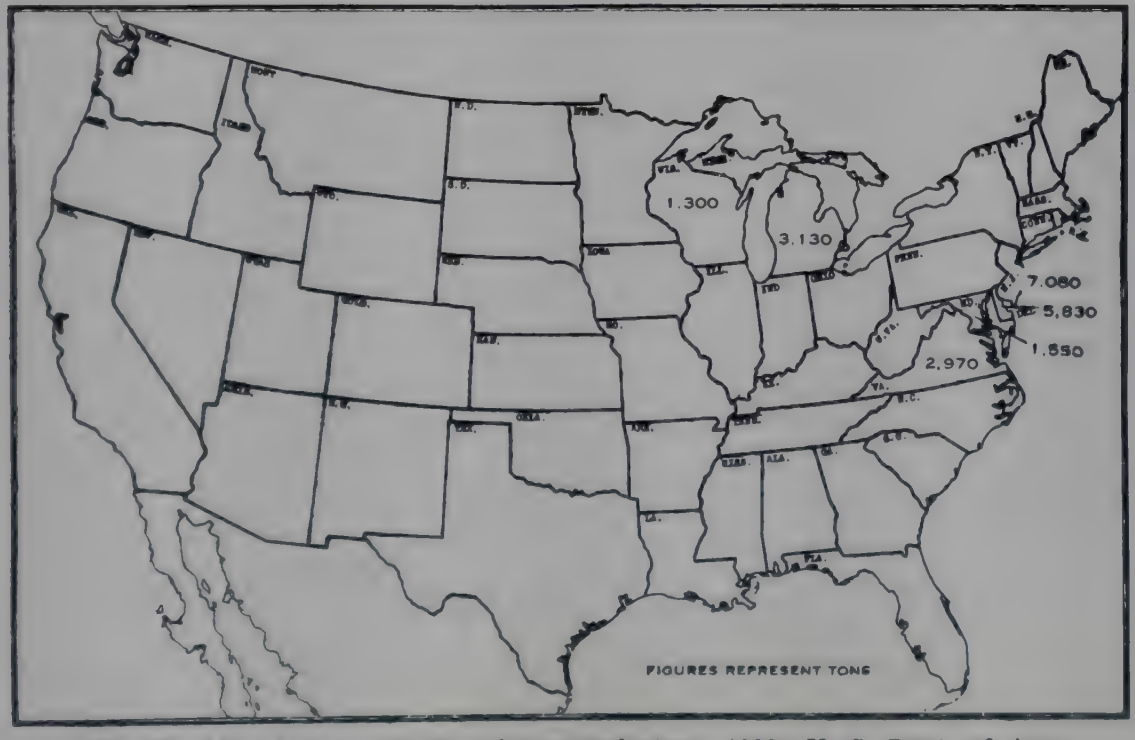

Fig. 33—Lima-bean production for manufacture, 1938—U. S. Dept. of Agr.

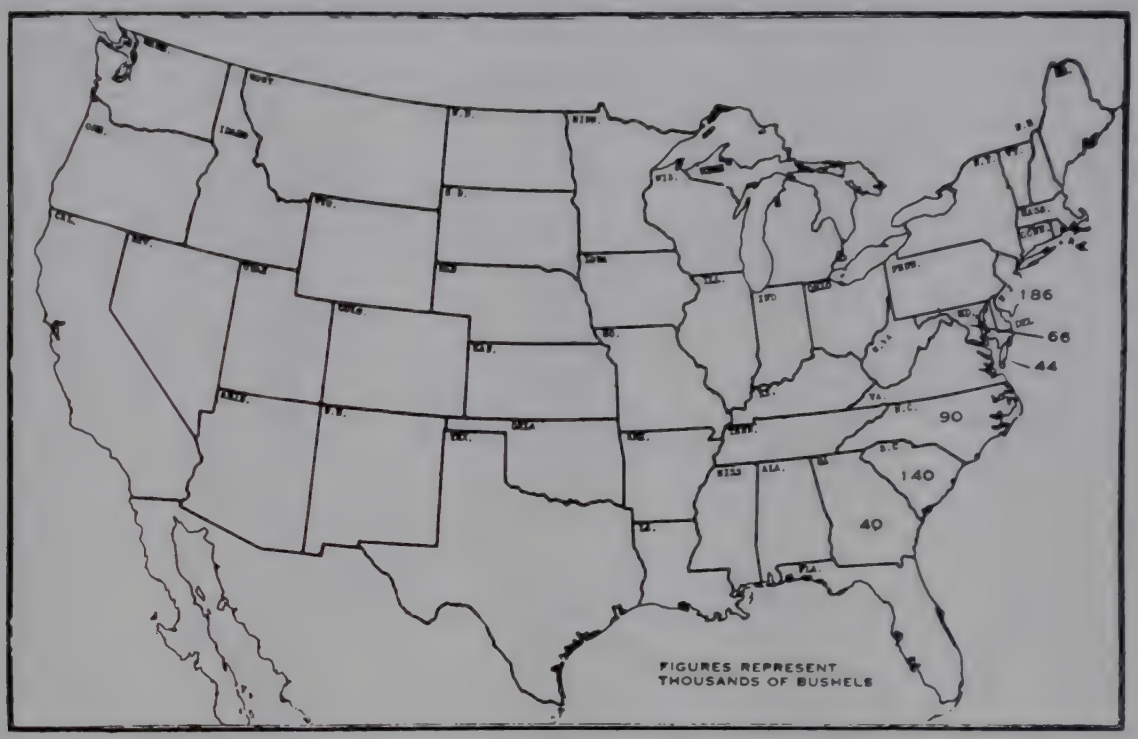

Fig. 34—Lima-bean production for market, 1938.—U. S. Dept. of Agr.

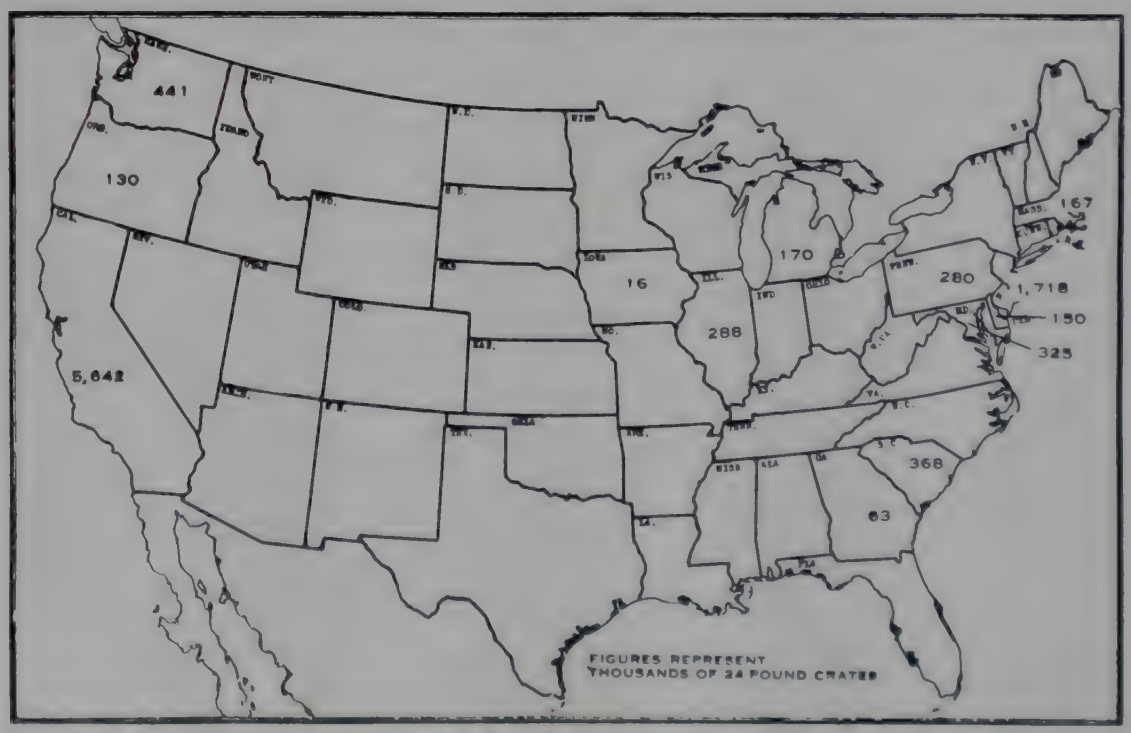

Fig. 35—Asparagus production for all purposes, 1938.—U. S. Dept. of Agr.

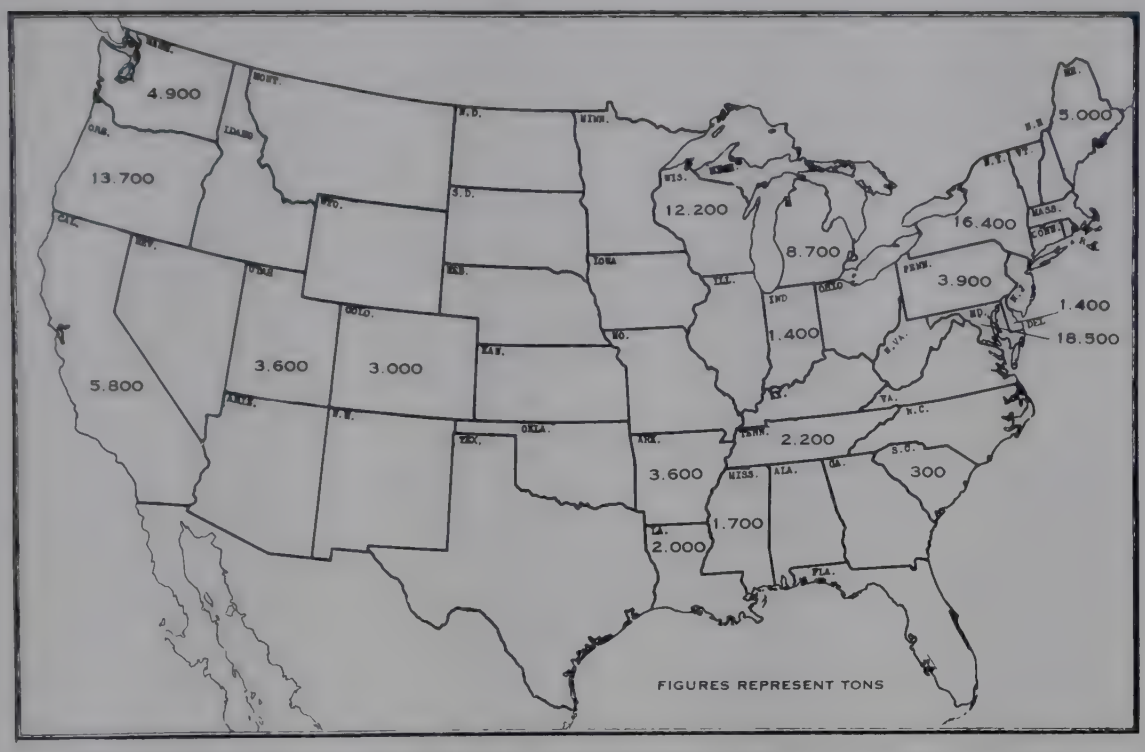

Fig. 36—Snap-bean production for manufacture, 1938.—U. S. Dept. of Agr.

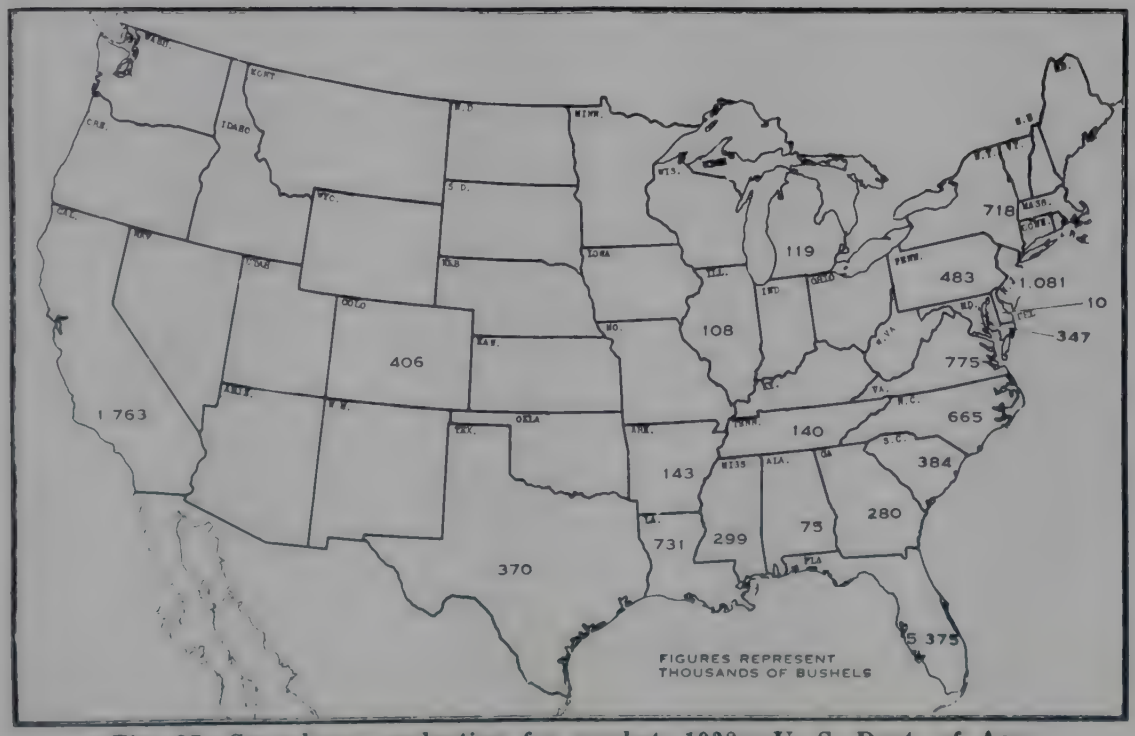

Fig. 37—Snap-bean production for market, 1938.—U. S. Dept. of Agr.

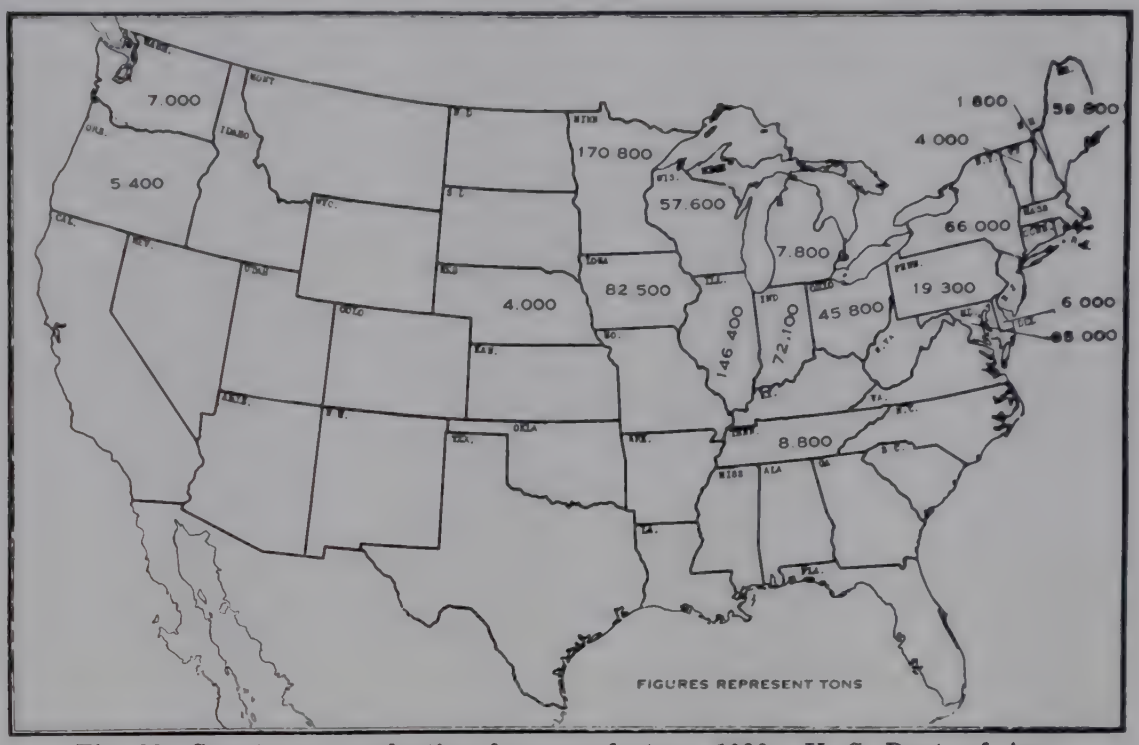

Fig. 38—Sweet-corn production for manufacture, 1938.—U. S. Dept. of Agr.

fresh market, has become one of the leading eastern strawberry cold-packing states. Virginia, another heavy eastern strawberry-freezing state, and Louisiana are the only "early" or "second-early" states which had 1938 acreages materially greater than their 10-year average for 1927-36, according to the Department of Agriculture Crop Report.

Continuing this comparison, the "late" group of states increased their 1938 acreage above their 10-year average by 7,250 acres. Oregon, with its heavy freezing operations, contributed almost 2,500 acres of this increase. Reports were received in 1937 that one packer was financing the planting of 1,000 acres of strawberries in Oregon to be used exclusively for a quick-frozen carton pack. Other "late" states in this group carrying on heavy freezing operations, are Michigan, New York, Pennsylvania, Utah, and Washington.

However, the "second early" group of states, which includes Tennessee, and which, with the exception of Virginia, did little freezing, had decreased their 1938 acreage by nearly 6,500 acres less than their 10-year average.

It is not safe to draw conclusions from such a short period, but the shift in acreage appears to have been toward those states engaged in freezing operations.

PEACH PRODUCTION

Figure 30, based on the average for 1927-36, gives a picture of peach production during that period. The Crop Report shows no defi-

nite trends since that time. The 52,498,000-bushel 10-year average dropped to 51,945,000 bushels in 1938. California cling peaches, used mainly for canning, and freestone peaches, used mainly for drying, show slight decreases, with their ratio remaining about the same in 1938 as for the 10-year average.

The state of Washington has been increasing its frozen-peach pack and shows a total 1938 production about 40 percent greater than the 10-year average. There is so little information available as to the volume of the frozen-peach pack, or the packing areas, that it would probably be misleading to connect crop figures with the freezing industry.

GREEN-PEA PRODUCTION

All types of peas used for both canning and freezing are included in the Crop Report figures for 1938, on which figure 31 is based. Unfortunately the Crop Reporting Board did not include figures for New Jersey, where there is a heavy pack of quick-frozen peas. In Oregon and Washington, where approximately one-half of the quick-frozen peas are packed, pea production increased from 22,000 tons in 1935 to over 43,000 tons in 1938. The Crop Report shows that the 10-year average for Washington and a short-term average for Oregon totaled 7,680 tons and the increase in these two states in 1938 accounted for over 30 percent of the total increase in the country in the same period. Other states known to be engaged in freezing peas also show large increases in tonnage during the same period; but there appears to be no way of separating peas used for canning from those used for freezing. In Wisconsin, where little, if any, freezing was done in 1938, the production for canning had increased about 35 percent above the 10-year average.

Figure 32, showing pea production for market in 1938, gives little indication of trend. The 962,000-bushel crop of 1935 in New Jersey and New York had dropped to 650,000 bushels in 1938, as compared to the 10-year average, 1927-36, of 721,000 bushels. The acreage for the two states dropped from the 10-year average of 9,410 to 7,430 in 1938. This may be a reflection of the effect of heavy shipments of frozen peas to New York City from other sections of the country during 1936, '37, '38. However, the early 1938 crops from the Imperial Valley, Florida, and Texas, were more than double their 10-year average, and New York City is their most important market.

LIMA-BEAN PRODUCTION

The lima-bean production for manufacture in 1938 (figure 33) was double that of the 10-year average, 1927-36—28,310 tons against 14,080. New Jersey, by far the largest lima-bean-freezing state, increased the 1929-36 average production of 1,450 tons to 7,080 tons

in 1938 and pushed its acreage up from 2,530 to 13,000. It appears that New Jersey, because of its freezing operations, is now processing about 25 percent of the total national canned and frozen lima-bean pack.

Figure 34, covering production of lima beans for the fresh market, shows that New Jersey's 1938 crop was 186,000 bushels, compared with the 1927-36 average of 222,000 bushels.

ASPARAGUS PRODUCTION

The Crop Report does not separate the asparagus produced for market and for manufacture (figure 35). It does, however, give separate figures covering canning operations in California, which in 1938 apparently processed about 38 percent of the total national production of 9,758,000 crates of 24 pounds. The California asparagus pack is an important part of the canned vegetable industry, amounting to over two million cases, or a production of around 90 million pounds, worth 4 to 5 cents per pound to the grower. The national quick-frozen asparagus pack is now estimated to be nearly 8 percent of the California canned pack and is increasing each year, while the canning pack has been practically stabilized, because of market conditions and control measures.

SNAP-BEAN PRODUCTION

The Crop Report does not include New Jersey, the center of the 5- to 6-million-pound eastern quick-frozen pack. The quick-frozen pack of about 4,000 tons in 1938 is too small in comparison with the total pack of over 120,000 tons to show any effect on trends in our national production of snap beans. Practically all sections of the country showed substantial increases in production for manufacture in 1938 (figure 36) over the 1927-36 average, which amounted to a total of 70,400 tons.

The production of snap beans for market (figure 37) increased from a 1927-36 average of 10,677,000 bushels to 14,278,000 in 1938. An important reduction in both acreage and production was made in New Jersey, which dropped from the 10-year average of 1,329,000 bushels to 1,081,000 in 1938. This may have been the result of competition with quick-frozen beans, as there was no material increase in the production of other states marketing their beans at the same time New Jersey does, or it may indicate a diversion of acreage from the fresh market to the freezing industry.

SWEET-CORN PRODUCTION

The Crop Report figures do not differentiate between the white and yellow corn used for canning and the yellow varieties that are

grown for quick-freezing. The 2,000 to 3,000 tons used for freezing is such a small part of the 876,000 tons produced for all processing in 1938 (figure 38) that no conclusions can be drawn concerning the effect of quick-freezing on the corn-processing situation. The Report shows that Oregon and Washington, which produced nearly one-half of the 1937 frozen pack, had increased their production from a short-term average of 2,200 tons up to 1936, to 12,400 tons in 1938. Obviously this increase was due to the greatly expanded canning operations, particularly in Washington. *Western Canner and Packer* says, "Continued crop failures in the Midwest focused attention on the far western states as a favorable growing area for canning corn. By 1937, the western pack reached a record of 431,402 cases." Also, by 1937, the national canned pack had almost come back to the record established in 1925.

The varieties of the various products now being produced in these localities for canning or for the fresh market, may or may not be suitable for freezing. The maps, however, do show areas of present production and indicate possible sources of raw-material supplies for frozen-food operations. This does not mean that freezing operations need be restricted to these localities. Many minor producing areas are not included in the Crop Report, and the possibilities of developing production in other areas is well illustrated by the important lima-bean-freezing operations now being carried on in California.

FRUIT AND VEGETABLE YIELDS

This chapter contains information secured during the survey, also table 8, based on the U. S. Department of Agriculture Crop Report covering the yields of the major fruits and vegetables now packed by the quick-frozen-food industry. Where possible, separate production information is given for the fresh market and for manufacture.

If it is desired to convert the fresh-market units into pounds for comparison with the yields for manufacturing purposes, the following factors are suggested—assuming average high-quality produce:

The standard 24-quart crate of strawberries will yield about 30 pounds net when capped.

A bushel of good-quality fresh peas or lima beans shells down to about 7½ pounds.

The average net weight of a bushel of string beans is 30 pounds.

In packing operations, trimming and grading will reduce the net weight in an amount depending upon the quality of the product and the grading standards of the packer.

STRAWBERRIES

Arizona agricultural authorities advised in 1937 that there were in that state about 150 acres in strawberries, mostly Klondike, and that the production averaged 4,500 pounds per acre.

The manager of a large central California growers' cooperative, raising Banner and Nick Ohmer berries, reported that a good patch two years old would produce nearly 11 tons per acre, but that the average was probably 6 tons.

The Crop Reporting Service at Sacramento advised that in 1936 the producers in northern California averaged 137 standard 24-quart crates per acre, while in the southern part of the state the average was 147.

Packers in the Salem, Oregon, area figured on a Marshall production of 1½ tons per acre; Ettersburg, ¾ ton; and Corvallis, 1¼ tons. One of the largest Oregon packers said their growers produced on an average, 1¾ tons of capped Marshall per acre.

A strawberry packer in Utah said that it was not unusual for a good grower of Marshall to get from 3 to 5 tons of capped berries the first crop year. The average for all his growers, however, was about 3,500 pounds. Another Utah packer reported that his best growers produced from 2½ to 3 tons of capped berries per acre.

Table 8 shows the long-term average yield of the leading strawberry-producing states, according to the U. S. Department of Agriculture Crop Report. The Tennessee yield is given as 47 standard 24-quart crates per acre, as compared with the following yields in the leading packing states:

	Crates
Florida	70
Louisiana	60
Virginia	70
New York	77
Michigan	60
Utah	64
Oregon	66
Washington	72

In our special strawberry-production survey of the 1935 crop in 16 Tennessee counties, the yield ran all the way from 12 crates per acre of Klondike in Lauderdale County to 155 crates of Blakemore in Gibson County, with an average of 66 crates per acre. The Crop Report gave a Tennessee state-wide average yield in 1935 of 55 crates.

A production-cost study, covering 3 acres of Blakemore strawberries in Gibson County, showed that the first crop, in 1935, yielded 283 crates per acre. The following year—one of unusually poor production in that section—showed a yield of 150 crates. The 283 crates were produced in a year when the county's average for the same variety of berry was 155 crates and the state average for all varieties was 66 crates. This example shows what can be done in Tennessee by the use of proper agricultural methods.

OTHER BERRIES

One of the outstanding berry producers of southern California reported that in 1936 his best field of Youngberries produced 7,000 pounds per acre; Macatawa blackberries, 7,500 pounds; Boysenberries, 11,500 pounds. His berries, grown under irrigation, were unusually large, and he reported that the Boysenberries averaged 60 berries per pound; Youngberries, 90 to 100; and blackberries, 120 to 160. He also stated that in 1935 he sold from his best acre $1,737 worth of Boysenberries through his retail stand, and that in 1936 he had 20 acres of Boysenberries, in which 125 pickers, at the height of the season, turned out $1,000 worth of berries per day.

One of the Oregon packers specializing in the quick-frozen carton pack reported his growers delivered to the plant 1½ tons of Cuthbert red raspberries and 2 tons of Youngberries per acre.

The Crop Report does not include information on berries other than strawberries.

TABLE 8—*Fruit and vegetable yields per acre—long-term average.*[1]

E=Early crop; F=Fall crop; L=Late crop; S=Spring crop; W=Winter crop.

State	Strawberries 24-qt. crate	Peas for manufacture	Peas for market 30-lb. bushel	Lima beans for manufacture	Lima beans for market 32-lb. bushel	Asparagus 24-lb. crate	Snap beans for manufacture	Snap beans for market 30-lb. bushel	Sweet corn for manufacture	Sweet corn for market Ears
North Atlantic										
	Number	Pounds	Number	Pounds	Number	Number	Tons	Number	Tons	Number
Maine	---	1,870	---	-------	---	---	2.5	-----	3.4	------
New Hampshire	---	-------	---	-------	---	---	---	-----	2.8	------
Vermont	---	-------	---	-------	---	---	---	-----	2.5	------
Massachusetts	---	-------	---	-------	---	93	---	-----	---	------
New York	77	1,270	81	-------	---	---	1.6	110	1.8	------
New Jersey	82	-------	67	1,160	75	98	---	116 L 96	---	4,900
Pennsylvania	65	1,880	---	-------	---	92	1.4	144	1.6	------
North Central										
Ohio	59	1,230	---	-------	---	---	---	-----	1.8	------
Indiana	65	1,740	---	-------	---	---	1.0	-----	1.5	------
Illinois	52	1,430	---	-------	---	55	---	46	2.0	------
Michigan	60	1,210	---	920	---	73	1.3	81	1.1	------
Wisconsin	48	1,440	---	1,030	---	---	1.4	-----	2.1	------
Minnesota	---	1,520	---	-------	---	---	---	-----	2.2	------
Iowa	56	-------	---	-------	---	58	---	-----	2.2	------
Missouri	39	-------	---	-------	---	---	---	-----	---	------
Nebraska	---	-------	---	-------	---	---	---	-----	1.5	------
Kansas	51	---	---	---	---	---	---	-----	---	------

South Atlantic											
Delaware	59	1,770	---	1,110	---	85	1.3	96	2.2	---	
Maryland	66	1,710	60	960	58	102	1.3	92 L 84	1.6	---	
Virginia	70	1,920	65	1,410	63	---	---	98 L 89	---	---	
North Carolina	85	---	69	---	52	---	---	77 L 68	---	---	
South Carolina	70	---	48	---	60	40	1.1	63 L 89	---	---	
Georgia	52	---	---	---	46	24	---	56	---	---	
Florida	70	---	60	---	---	---	---	F 88 W 91 S 79	---	---	
South Central											
Kentucky	57	---	---	---	---	---	---	---		---	
Tennessee	47	---	63	---	---	---	1.1	67	2.4	---	
Alabama	75	---	60	---	---	---	---	63		---	
Mississippi	53	---	70	---	---	---	.8	E 66 L 44	---	---	
Arkansas	43	---	---	---	---	---	1.1	52	---	---	
Louisiana	60	---	54	---	---	---	1.0	E 67 L 56	---	---	
Oklahoma	32	---	---	---	---	---	---	---	---	---	
Texas	56	---	54	---	77	---	---	F 54 E 75	---	---	
Far Western											
Montana	---	2,300	---	---	---	---	---	---	---	---	
Idaho	---	---	98	---	---	---	---	---	---	---	
Colorado	---	1,760	75	---	---	---	2.5	153	---	---	
New Mexico	---	---	E 76 L 141	---	---	---	---	---	---	---	
Arizona	---	---	---	---	---	---	---	---	---	---	
Utah	64	2,350	---	---	---	---	2.8	---	---	---	
Nevada	---	---	---	---	---	58	---	---	---	---	
Washington	72	2,250	180	---	---	105	3.5	---	2.1	---	
Oregon	66	1,830	127	---	---	104	4.3	---	1.5	---	
California—Southern	185	---	E 82 L 46	---	---	---	---	---	---	---	
California—Other	194	---	E 79 L 99	---	---	104	4.0	179	---	---	
U. S. Average	62.2	1,555	77	1,110	63	92	1.45	85	1.95	---	

[1]U.S.D.A. Crop Report.

PEACHES

Very little information was located regarding the yields of peaches. One of the Oregon packers said that the yield varied a great deal, but they based their production estimates on an average yield of 2 tons per acre.

A private investigator, reporting on the California freestone peach, figured a total production, in 1936, of 175,000 tons from 48,500 bearing acres—approximately 3.6 tons per acre.

VEGETABLES

Packers' records in the important vegetable-freezing area around Portland, Oregon, showed the following average yields, as delivered to the packing plant:

	Tons per acre
Spinach	5
Asparagus	2
Peas (shelled)	1½
Wax beans	2½
Green beans (Kentucky Wonder)	3
Sweet corn (Golden Cross)	2¼
Broccoli (Green Italian)	3
Squash (Hubbard-Golden Delicious)	8
Cauliflower	4
Brussels sprouts	2

The California Crop Reporting Service showed the following average production for canning in 1936:

	Tons per acre
Asparagus	1.4
Green beans	4.2
Spinach	3.2
Green peas	.81

Probably the best obtainable picture of comparative average yields of various vegetables in the major producing states is table 8, based on the Crop Report. For the most part these are averages over a 10-year period. It is interesting that Tennessee's sweet-corn yield of 2.4 tons per acre for canning was exceeded only by Maine, New Hampshire, and Vermont.

PRICES PAID GROWERS

In addition to the information secured during the 1937 survey, this chapter includes table 9, comparing the U. S. Crop Report figures for the various producing states on a long-term average, in most cases for the 10 years 1927-36. Where available, separate figures are given for fresh-market and manufacturing production. In the absence of long-term average returns for peaches, the 1937 crop was used in making up the table, but it must be kept in mind that wide swings in peach prices occur because of varying production and market conditions.

Table 10 shows the prices paid since 1927 by frozen-fruit packers of the Northwest for capped strawberries and other fruits. The prices paid for all fruits in the Northwest were unusually high in 1937—in some cases the highest on record—although in the case of strawberries the Oregon and Washington yields and production were above the 10-year average.[2]

In the case of berries other than strawberries, particularly Loganberries, packers complained that the wineries were bidding up prices, which may account to some extent for the 2- to 3-cent increase in price in 1937 over 1936.

STRAWBERRIES

The Louisiana packing centers were visited the middle of May, 1937—in the latter part of a season during which approximately 5,700,000 pounds of berries were frozen. The packers buy berries which are too ripe for shipment, surplus, and low-priced end-of-season fruit. They paid the growers as high as 7 cents per pound for capped berries during the early part of the season, but the price had dropped to 5 cents by the latter part of April, and 4 cents was posted on May 14, when most of the packers were shutting down on account of lack of freezer storage facilities.

One of the growers, who keeps records of his sales, gave the following information from his books:

Date	For freezing Per pound	For fresh market Per crate
April 20	5c	$2.33
April 23	6c	——
April 26	5c	——
May 1	5c	$1.30
May 13	5c	$1.00

The fresh-market prices are based on 24-pint crates and are net after deducting 10 cents per crate for his association and an 8-cent auctioneering fee, but include a crate expense of 22 cents. The ber-

[2]See "Selling Prices"—"Cold-Pack Fruits", page 56.

TABLE 9—*Fruit and vegetable prices received by growers—long-term average.*[1]

E=Early crop; F=Fall crop; L=Late crop; S=Spring crop; W=Winter crop.

State	Strawberries 24-qt. crate	Peaches 1937 Bushels	Peas for manufacture Tons	Peas for market 30-lb. bushel	Lima beans for manufacture Tons	Lima beans for market 32-lb. bushel	Asparagus 24-lb. crates	Snap beans for manufacture Tons	Snap beans for market 30-lb. bushel	Sweet corn for manufacture Tons	Sweet corn for market 1,000 ears
North Atlantic											
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Maine	----	----	59.40	----	----	----	----	46.80	----	19.00	----
New Hampshire	----	1.40	----	----	----	----	----	----	----	18.40	----
Vermont	----	----	----	----	----	----	----	----	----	14.10	----
Massachusetts	----	1.60	----	----	----	----	2.50	----	----	----	----
New York	3.15	1.00	54.80	1.30	----	----	----	61.20	.85	13.50	----
New Jersey	2.35	1.00	----	1.20	102.25	1.65	1.75	----	L 1.05	----	13.60
Pennsylvania	2.65	1.00	53.80	----	----	----	1.75	44.60	1.00	12.10	----
North Central											
Ohio	2.95	1.30	43.90	----	----	----	----	----	----	8.90	----
Indiana	2.55	1.15	43.80	----	----	----	----	47.50	----	10.30	----
Illinois	2.40	1.25	50.80	----	----	----	1.85	----	1.25	10.00	----
Michigan	2.75	.95	47.50	----	57.44	----	1.60	47.80	1.10	11.20	----
Wisconsin	2.95	----	54.10	----	68.26	----	----	55.90	----	9.40	----
Minnesota	----	----	48.00	----	----	----	----	----	----	8.80	----
Iowa	3.15	1.10	----	----	----	----	1.90	----	----	7.90	----
Missouri	2.80	.95	----	----	----	----	----	----	----	----	----
Nebraska	----	1.40	----	----	----	----	----	----	----	7.20	----
Kansas	2.60	1.25	----	----	----	----	----	----	----	----	----

South Atlantic												
Delaware	2.10	1.00	53.90	-----	60.31	-----	1.60	41.90	1.00	10.30	-----	
Maryland	2.10	1.05	54.60	.95	64.42	1.90	1.75	46.30	1.05 L .95	11.60	-----	
Virginia	2.35	1.10	54.10	.85	64.50	1.85 L 1.35	-----	-----	1.10 L 1.00	-----	-----	
North Carolina	2.60	1.55	-----	.95	-----	1.25	-----	-----	.95 L 1.10	-----	-----	
South Carolina	2.70	1.40	-----	1.05	-----	1.45	1.95	37.20	1.00 L 1.25	-----	-----	
Georgia	2.50	1.45	-----	-----	-----	1.35	1.95	-----	.90	-----	-----	
Florida	5.35	1.00	-----	1.80	-----	-----	-----	-----	F 1.80 W 2.45 S 1.45	-----	-----	
South Central												
Kentucky	2.70	.90	-----	-----	-----	-----	-----	-----	-----	-----	-----	
Tennessee	2.00	1.00	-----	1.25	-----	-----	-----	40.00	.95	12.00	-----	
Alabama	2.45	1.25	-----	1.15	-----	-----	-----	-----	1.00	-----	-----	
Mississippi	2.75	1.30	-----	1.15	-----	-----	-----	40.90	1.05	-----	-----	
Arkansas	2.25	1.15	-----	-----	-----	-----	-----	44.40	.95	-----	-----	
Louisiana	4.25	1.25	-----	1.70	-----	-----	-----	38.90	1.00	-----	-----	
Oklahoma	2.40	1.10	-----	-----	-----	-----	-----	-----	-----	-----	-----	
Texas	4.30	1.20	-----	1.25	-----	1.85	-----	-----	F 1.20 E 1.35	-----	-----	
Far Western												
Montana	-----	-----	44.00	-----	-----	-----	-----	-----	-----	-----	-----	
Idaho	-----	1.85	-----	1.05	-----	-----	-----	-----	-----	-----	-----	
Colorado	-----	.90	42.90	1.20	-----	-----	-----	48.60	.85	-----	-----	
New Mexico	-----	1.35	-----	-----	-----	-----	-----	-----	-----	-----	-----	
Arizona	-----	1.50	-----	1.75 L 1.60	-----	-----	-----	-----	-----	-----	-----	
Utah	2.20	1.85	51.60	-----	-----	-----	-----	45.10	-----	-----	-----	
Nevada	-----	1.75	-----	-----	-----	-----	1.55	-----	-----	-----	-----	
Washington	2.45	.95	51.00	1.05	-----	-----	1.50	49.80	-----	11.70	-----	
Oregon	2.40	1.20	55.80	1.20	-----	-----	1.75	56.20	-----	14.00	-----	
California-Southern	3.45	-----	-----	E 2.15 L 1.80	-----	-----	-----	-----	-----	-----	-----	
California—Other	3.20	.61	-----	E 1.40 L 1.85	-----	-----	Mkt.1.70 Mfr. .86	71.90	E 1.30 L 1.20	-----	-----	
U. S. Average	2.84	1.019	52.30	1.39	67.87	1.28	1.31	50.73	1.28	10.60		

[1]U.S.D.A. Crop Report.

TABLE 10—*Fresh-fruit prices paid by northwestern frozen-fruit packers, hulled, per pound.*[1]

Year	Straw-berries	Red rasp-berries	Black rasp-berries	Logan-berries	Black-berries	Goose-berries	Cher-ries	Cur-rants	Young-berries
1927	.05½	.07	.....	.05	.04	.....	.....	.....	.....
1928	.06	.08¼	.....	.04½	.03½	.....	.....	.....	.....
1929	.06	.08½	.....	.05	.04	.....	.....	.....	.....
1930	.08	.09½	.....	.05½	.04½	.....	.....	.....	.....
1931	.06	.06	.....	.05	.03½	.....	.....	.....	.....
1932	.02	.03	.....	.01½	.01½	.....	.....	.....	.....
1933	.05	.05½	.....	.02½	.02	.....	.....	.....	.....
1934	.04	.04	.04	.02½	.02	.02	.02½	.02½	.04
1935	.05	.06½	.06	.03	.02½	.02½	.02½	.04	.04
1936	.05	.05	.06½	.04	.03	.03	.02½	.04	.03½
1937	.08	.08½	.08½	.07	.05	.05½	.05	.05	.06½
1938	.05	.05½	.05	.03	.02¾	.03¾	.02¾	.....	.03
1939	.05	.05½	.06	.02½	.02½	.03	.02½	.04	.02½

[1] *Western Canner and Packer* Yearbook.

ries for freezing are capped and sold to the packer from field containers.

The U. S. Crop Report lists the Louisiana growers as receiving in 1937 an average of $3.50 on a 24-quart-crate basis. Assuming a capped weight of 30 pounds per crate the average would amount to slightly over 11½ cents per pound.

Florida, like Louisiana, is a heavy fresh-market-producing state, and the same general conditions exist with respect to the berry supply, except that the state requires that all berries be capped in the packing plant. The cost to the packer for capping was 1½ cents per quart in 1937, but has been increased by the minimum wage laws. The leading packers advised that in capping and grading they discarded about 25 percent of the berries purchased. In 1937, one of the packers paid prices varying from 4 to 7 cents per quart, while the other figured his average at 5 cents per quart, the range during the season being from 4.2 cents to 9.75 cents per quart.

The U. S. Department of Agriculture reports that Florida growers received an average of $4.80 per 24-quart crate in 1937, or 16 cents per pound on a capped-weight basis of 30 pounds.

A northern operator packing strawberries in Alabama stated that his berries cost him 5½ cents per pound, capped and delivered to the plant, in 1937—a price in line with prices reported as paid by the Louisiana packers in the same year.

There was very little strawberry processing, either canned or frozen, in California in 1937. It was estimated that the Central California Berry Growers Association, which operates in six counties of central California, produced about one-third of the entire state crop. In the early summer of 1937 the canners were paying the Association 8½ cents per pound for capped berries delivered in canners' flats.

The U. S. Department of Agriculture reports that the average price received by California growers in 1937 was $2.95 per 24-quart crate, or slightly less than 10 cents per pound, net capped weight.

One of the largest Oregon packers of frozen strawberries, specializing in the carton pack, said he was paying the growers 7 cents per pound for capped Marshall strawberries delivered at the plant. A small Oregon packer said his 1937 berries cost him 8 cents per pound.

With the exception of a few large packers of frozen fruits, the major portion of the Oregon pack is in the hands of cooperatives, and the actual return to the grower is difficult to determine. One of the largest of these cooperatives stated that its 1937 pack of 2/1 Marshall in 50-gallon barrels cost 3.38 cents per pound, exclusive of the value of the berries (in this pack there are 300 pounds of berries and 150 pounds of sugar to the 450-pound barrel). In the early part of August, 1937, the cooperative's sales agents were quoting 12½ to 12¾ cents per pound for this pack, of which one-third was sugar. If they succeeded in selling the entire pack at this figure—which is extremely doubtful—one might conclude that the cooperative sold the berry part of the pack for slightly more than 13½ cents per pound. From this must be deducted the general association operating expense, as well as a sales brokerage of 4 percent. In addition to putting up a wide variety of types of packs of frozen berries this cooperative engages in canning operations and sells berries in the fresh market. The various operations of the cooperatives involve numerous separate pools, each of which would have to be studied to determine the actual return to the grower—a difficult task for an outsider.

A large part of the Oregon strawberry crop is marketed in frozen form, and, as previously stated, is largely in the hands of cooperatives. The Department of Agriculture reports that the Oregon growers received in 1937 an average of $3.35 per 24-quart crate, or over 11 cents per pound on a capped-weight basis. This does not agree with reports of private packers that they paid from 7 to 8 cents in 1937, unless the cooperatives were able to secure a much higher average return for their members.

In the important frozen-strawberry-packing state of Washington, at least two of the large packers secure supplies of berries from small growers, by operating cooperative pools similar to those of the regular cooperatives. The packer enters into an agreement with the growers to pool all fruit, including any purchased outright by the packer. From the total returns the packer deducts all handling and packing costs, and 7 percent of the gross sales; this 7 percent covers administrative overhead, rent, etc., and profit for handling the pool. The remainder is divided with the various growers in proportion to the amounts supplied. Actual returns to the growers under this method of operation could not be determined, but it was reported that

growers continued marketing through such pools year after year with apparent satisfaction.

Table 10 indicates that the northwestern packers paid an average of 8 cents per pound for capped berries in 1937, and the U. S. Department of Agriculture reports that in Washington the average return to growers for all methods of marketing amounted to $3.00 per 24-quart crate, or 10 cents per pound on a capped-weight basis. Washington packers who gave a break-down of the cost of packing valued the berries at 8 cents per pound in their 1937 operations.

Utah packers said that capped berries cost them 8 cents, in 1937. One Utah packer has made it a practice for several years to guarantee his growers 7 cents per pound capped. If the selling price of 2/1 cold-pack berries runs over 9¼ cents and the pack is sold by the end of the first month's storage, he divides equally with the grower all over 9¼ cents. If there are additional storage charges, they are deducted before the division is made. He said that he had lost under this plan several times, but that in general both he and the growers are satisfied with the arrangement. According to the Department of Agriculture, the average return to Utah growers was $3.00 per crate, or 10 cents per pound, on a capped-weight basis.

Two prominent Michigan strawberry packers said they packed only to fill orders placed in advance of the packing season. They had to compete with the fresh market, and in 1937 paid the equivalent of 6 cents per pound for berries not capped, which represented a figure close to 9 cents after capping. The Department reports that the average return for Michigan was $2.55 per crate, or about 8½ cents on a capped-weight basis.

OTHER BERRIES

The Crop Report does not cover berries other than strawberries, but table 10 gives a record of the prices paid by the packers in the Northwest.

At the present time, next to the strawberry, Tennessee is principally interested in the Youngberry. The survey located three major Youngberry packing centers — the areas surrounding Los Angeles, Portland (Oregon), and Seattle.

One Los Angeles packer stated in 1937 that he was paying growers 5 cents per pound for Youngberries, and another that he was paying from 5 to 6 cents. At the field, growers were selling small quantities of berries in flats containing 8 pounds for from 65 to 85 cents.

One of the large Oregon packers, putting up a carton pack for the institutional and retail trades, reported paying 5½ cents for Youngberries. According to table 10, the northwestern packers gen-

erally reported paying the unusually high price of 6½ cents in 1937.

The Boysenberry freezing operations in 1937 centered in the Los Angeles area, where prices paid were about the same as for Youngberries. It was observed that in many cases the less well-known Boysenberry was sold as a Youngberry and at the same price.

PEACHES

Table 9 shows that for peaches for all purposes, in 1937, the growers received average prices ranging from $1.00 to $1.55 per bushel, or from 2 to 3 cents per pound, assuming 50 pounds to the bushel. According to one of the leading Philadelphia processors of cold-pack peaches for the ice-cream industry, a large proportion of the peaches for freezing are bought in the Philadelphia fresh market. The peaches originate for the most part in the East Coast states from Georgia to Delaware. One packer said that he had bought Georgia peaches at lower prices in the Philadelphia fresh market than he had offered for bulk peaches at the orchards.

A great deal of the carton pack of peaches for the institutional and retail trades comes from Oregon, and one of the largest packers advised that in 1937 he paid the growers 2 cents per pound for bulk peaches delivered at the packing plant.

Although California packs about 85 percent of the national pack of canned peaches, little cold-pack, if any, was being put up there in 1937. One large eastern distributor is reported to have started an experimental pack in 1938. The California peach situation is so confused by periods of over-production and heavy carry-overs, by optimism followed by depression, and by all sorts of agreements controlling the volume of pack and selling price, that there is little price information obtainable which would be applicable to the frozen-fruit industry. Also the bulk of the crop consists of clings for canning, while freestones only are used for freezing. According to table 9, the Department of Agriculture reports that in 1937 the California growers received an average of but 61 cents per bushel for freestones — by far the lowest return in the country. Preliminary reports for 1938 place the return even lower, at 46 cents.

RED SOUR CHERRIES

The red sour cherry pack is nearly all bulk pack for the commercial pie baker. Washington and Oregon have been rapidly building up their output of frozen red sours to compete with the eastern packs. Their 1937 pack was almost 3,000,000 pounds, about 9 percent of the national total. According to table 10, their growers received an average of 5 cents per pound. The U. S. Department of Agriculture reports that the growers received $78.00 per ton in the important

frozen-pack state of New York, and $81.00 in Michigan, second in volume of pack. The Department does not make separate reports on sour cherries in the other producing states.

PEAS

The Crop Report figures for the long-term average price received by growers of peas for manufacture are given in table 9. These figures are general averages covering peas of all varieties for both canning and freezing. The Report gives no indication of the prices paid for different varieties or of the various methods of payment which attempt to pay the grower in proportion to the quality of his crop and its actual value to the processor. A ton of high-grade peas, naturally, will produce more goods which can be sold at the higher price levels than will a ton of poor peas, and will cost the packer less to handle. Packers' contracts show a widespread movement on the part of packers to pay for what they get and at the same time offer the grower inducements to produce higher-quality products. In general, these methods apply to the different vegetables commonly used for both quick-freezing and canning.

One of the largest quick-frozen pea packers in Oregon said that he paid his growers an average of $60.00 per ton for shelled peas in 1937, while the U. S. Department of Agriculture reports the average for the state for all types of manufacture as $55.30. This packer has worked out a sliding-scale payment based on the percentage of tender peas in each load delivered to the packing plant. He classed as tender a pea which can be mashed between the thumb and forefinger without splitting. The peas are divided into 9 grades, according to the percentage of tenders as determined by a fair representative sample of the threshed peas. Pea deliveries containing less than 53 percent of tenders are rejected, because of the large losses and increased handling and inspection costs. The packer stated that this method was successful and well received by the growers and that its use would be extended.

In Washington, where there is heavy packing of quick-frozen peas, the Department reports an average price to the growers in 1937 of $49.20 per ton. One of the large pea packers, who reported packing 700 tons of quick-frozen peas in institutional paperboard cartons, in the same year, stated that he had paid the grower an average of $65.00 per ton.

According to the Crop Report, New York State ranked second—$60.90 per ton—in the average price paid growers for peas for manufacture in 1937. One of the largest packers, in his contract for peas "for canning purposes or for freezing purposes," agreed to pay $62.50 per ton for fancy shelled Alaska, Surprise, Wisconsin Sweet, Climax,

Perfection, Profusion, and Roger's C peas, and $65.00 for fancy shelled Laxton or Telephone peas.

A southeastern packer who froze about 25,000 pounds of peas in 1937 had to buy hand-picked peas from fresh-market producers, and said they cost him $130.00 per ton shelled.

One of the large eastern frozen-pea packers uses a very simple contract, in which, for the 1937 crop, he agreed "to pay the grower for threshed peas $80.00 per ton. Weight to be taken at packer's factory with 5 percent dockage allowance for waste material unavoidably included with peas at time of vining." With the exception of one or two eastern cases, we did not find the canners generally providing for a waste-material dockage allowance in their contracts.

The U.S.D.A. figures are necessarily averages and can be used only in very broad state-by-state comparisons. Care should be exercised in attempting to draw conclusions from them. So far as any individual grower is concerned, his return is affected not only by yield, but by variety of peas raised and by size and quality. There are many factors that may carry his return a long way above or below the average for his state.

LIMA BEANS

According to the Crop Report, about 70 percent of the national 23,220-ton production of green lima beans for manufacture in 1937 was in the states of New Jersey, Delaware, Maryland, and Virginia. The average price paid growers per ton was, respectively, $80.00, $58.20, $60.30, and $60.00. The major part of the quick-frozen lima-bean pack was made in these states.

One of the leading packers of Henderson bush lima beans, for freezing, bases his schedule of payments to the grower on the percentage of bright, unbroken, green beans delivered from the viner, as follows:

Percent green	Price per ton	Percent green	Price per ton
100	$120.00	87	74.00
99	117.00	86	72.00
98	115.00	85	70.00
97	112.00	84	67.00
96	110.00	83	65.00
95	105.00	82	62.00
94	100.00	81	60.00
93	95.00	80	57.00
92	90.00	79	54.00
91	85.00	78	52.00
90	80.00	77	49.00
89	78.00	76	46.00
88	76.00	75	43.00
		74 and less	40.00

Comparing the above schedule with the reported $80-per-ton average paid in New Jersey, for example, it can be seen that the

grower may receive anywhere from 50 to 150 percent of the average.

SNAP BEANS

While the Crop Report shows that the snap-bean growers in the state of Oregon were paid on an average $59.20 per ton in 1937, a packer of high-grade quick-frozen beans stated that in the same year he had paid an average of $55.00 per ton.

ASPARAGUS

Western Canner and Packer states that in 1937 the California asparagus canners paid the growers from 4 to 4½ cents per pound for white, and 5 to 5¼ cents for green, the greater part being sold at 4 and 5 cents respectively. At the beginning of the season, prices were 3¾ and 4¾ cents. Oregon canners paid 5½ cents for all-green. (The all-green asparagus is the type packed by the frozen-vegetable packer.) The magazine also quotes the following weighted average prices paid growers for California asparagus:

Season	White Cents per pound	All-green Cents per pound
1932	2.64	2.383
1933	2.38	2.090
1934	3.22	3.580
1935	3.64	4.258
1936	3.83	4.473
1937	4.25	5.404

The Crop Report gives figures on asparagus for manufacture, covering the California crop only. It reports that during the 10-year period 1927-36 the growers received an average of $70.60 per ton, and in 1937, $90.95. This presumably covers both white and all-green.

A large packer of high-grade frozen asparagus in Oregon stated that he paid his growers $100.00 per ton for the 1937 pack.

In the same year a leading eastern packer of frozen asparagus, in the area putting up about 85 percent of the national frozen pack, advised that he paid growers for the 1937 crop as follows:

	Cents per pound
Large—⅝ inch and up	8
Medium—⅜ to ⅝ inch	7
Small—¼ to ⅜ inch	2
Culls	2

The packer specified that all asparagus except the culls should be of the No. 1 grade: "The length of green asparagus shall not exceed 9 inches, including ½-inch tolerance for white, and not less than 4½ inches of the stalk length shall be of a green color. Spears over 9 inches in length shall be trimmed to the 9 inches maximum length and placed in proper size and grade, the excess length declared as Butts."

"The No. 1 asparagus to be fresh and not badly misshapen, free from decay and broken tips, and from damage caused by spreading tips, dirt, disease, insects and mechanical or other means. Culls are stalks which do not meet the No. 1 grade, but to be acceptable must be free from decay and serious damage caused by dirt, disease and beetle injury; and the stalks shall be of a green color not to exceed 9 inches including ½-inch tolerance for white."

The best-quality retail carton pack is made from the medium-size cut to a 5-inch length, for which, under this particular contract, the grower received 7 cents per pound, compared with the weighted average for the California canner of 5.4 cents.

SWEET CORN

Approximately 40 percent of the 1937 quick-frozen sweet-corn pack came from the northwestern states of Oregon and Washington. An Oregon packer—one of the largest in that area—said that he paid his growers $15.00 per ton for Golden Cross sweet corn. According to the Crop Report, which covers all varieties of sweet corn used for manufacture, the average price paid the growers in Oregon was $13.90, and in Washington $12.40. The weights include the husk as harvested.

MISCELLANEOUS VEGETABLES

The Oregon packers of frozen spinach reported paying the growers $16.00 per ton in 1937. This compares with $27.50 in Maryland, $11.00 in Texas, and $13.35 in California, the only states reported on by the Department of Agriculture. In the same year a South Carolina canner was paying $20.00 per ton for both spinach and turnip greens.

Other Oregon prices were:

	Per ton
Broccoli	$40.00
Squash	5.00
Cauliflower	20.00
Brussels sprouts	60.00

The U. S. Department of Agriculture does not report on these vegetables.

BERRY-HARVESTING COSTS

Considerable variation exists in the methods of paying fruit pickers and the rates paid, in the various sections of the country. A detailed study of the cost of production of strawberries in West Tennessee, showed that the picking cost for the fresh market amounted to 47.2 percent of the total production cost delivered to the railroad. It is apparent that in all berry-producing sections the picking cost constitutes the major production-cost item.

The early high-priced Louisiana strawberry crop, for the most part, is sent to the fresh market in 24-pint crates. A Louisiana grower advised that he paid pickers 36 cents per crate when the price per crate was $2.25 or more, and 30 cents when the price went lower. Packing the berries for the fresh market cost him from 10 to 12½ cents per crate. When berries were picked for the frozen-fruit packer, the picking rate was 1¼ cents per pint, and 1 cent per pint additional for capping. This does not leave the grower much margin when he is selling the capped berries to the packer for 5 to 6 cents per pound, but whatever he gets out of the deal is clear profit, as otherwise the berries would go to waste.

One of the largest berry growers of southern California said his 1937 picking cost for Youngberries, Boysenberries, and Loganberries was 15 cents per "flat" holding 8 pounds of berries. The cost for strawberries and red raspberries was 30 cents per "flat" of 9 pounds. A considerable quantity of the first three berries went to frozen pack, but the latter berries went to the fresh market.

In central California the 12-pint crate was commonly used for fresh-market shipment of strawberries, and the pickers were paid 40 cents per hour. The raspberry pickers were paid from 30 to 35 cents per crate containing about 6 pounds of berries.

In the heavy berry-producing sections of Oregon two cooperatives and a commercial firm operated a joint pool for allocating the fruit to the fresh market, to the canner, or for freezing. They combined in posting bulletins giving instructions for the proper picking and handling of berries, and fixing the picking rates for the 1937 season. The picking rates were as follows:

	Cents per pound	
Strawberries, hulled	1½	bonus ½
Raspberries	2½	bonus ½
Loganberries	1	bonus ½
Blackberries	1	bonus ½
Boysenberries and Youngberries	1	bonus ¼
Black raspberries	2	bonus ½

The bonus is intended as an inducement to the pickers to stay on the job through the entire season, including the lean early and late picking periods. The bulletin states, "Anyone who quits picking, except for unavoidable reasons, while still needed, or who is dis-

charged for unsatisfactory service, or for violation of rules, or objectionable conduct is not entitled to bonus."

In Michigan the strawberries usually are packed in 16-quart crates. The pickers were paid 48 cents per crate in 1937. The black-raspberry-picking rate varied from 2½ cents to 3 cents per quart, and for cherries picked without stems the rate was 1 cent per pound.

A study of West Tennessee strawberry production costs showed a picking cost per 24-quart crate of 48 cents. Converting the above picking costs in other states to the 24-quart-crate basis, the reported picking costs would be approximately as follows:

West Tennessee	$ .48
Louisiana	.72
Southern California	1.20
Oregon	.60
Michigan	.72

PART III—PROCESSING OPERATIONS

GENERAL QUALITY CONTROL

Processing operations for the preservation of fruits and vegetables by freezing closely parallel canning operations, up to the time when the prepared food goes into the freezer instead of the cooker. The main difference in handling the products up to this point is the necessity for meticulous care in preserving the "freshness"—that is, the color, texture, flavor, and vitamin content—and keeping down the bacterial count. Frozen foods, essentially, are preserved fresh foods, while canned foods are preserved cooked foods.

It is true that canning operations should be and usually are carried on with dispatch, care, and cleanliness; but in canning, the food is sterilized by heat after it is sealed in the can, stopping all bacterial growth and enzymic action and preventing spoilage, so long as the can remains sealed. The long cooking not only destroys the appearance of freshness, but equalizes differences in maturity, color, flavor, or texture of the individual pieces; and the result is a homogeneous product.

In quick-freezing operations, any loss of the characteristics of freshness during the preparation process or during freezing can neither be regained nor concealed. The best of the quick-freezing methods can add nothing to appearance or quality; in fact, the success of any freezing operation is measured by the moderateness of its destructive effects. And freezing will not equalize differences in maturity, color, or general quality.

Frozen food which has been allowed to deteriorate at any stage of the preparatory operations, or which has been subjected to fluctuating or too high temperatures during storage or transportation, or exposed to dehydration on account of inadequate packaging protection, will show the effects, in color, flavor, texture and vitamin losses. The deterioration is liable to be even more apparent both as to appearance and flavor than similar losses of quality in fresh fruits and vegetables; and the off-quality frozen product is even less salable than stale, wilted fresh produce, which usually can be unloaded on some careless housewife, on a telephone order, or sold at reduced price to a "bargain hunter." The consumer expects a standard quality in a packaged product, and resents variations which would be taken as a matter of course in buying fresh fruits and vegetables in a city market.

The mushroom growth of the industry in 1936 and 1937, together with the apparent wide margin of profit, attracted numerous inexperienced operators, who apparently made no effort to learn from the experiences of established packers. It was observed in some processing plants that even the simplest, most widely published findings of the many independent research workers were being ignored. Considering the information available, especially on bacteriological, vitamin, and general-quality control, there seems little excuse for many of the things that have been done. Much of the carry-over stock and many failures in the frozen-food industry have been due to poor-quality if not entirely unsalable packs, rather than to overproduction.

The frozen-food packer's responsibility, like the canner's, starts with the selection of the growing area, perhaps even with the selection of the individual fields in the growing area. Experiments made by the New York State Experiment Station with 12 varieties of spinach showed that the same varieties averaged 50 percent higher in vitamin C content when grown on upland soil than when grown on muck land. They concluded that the kind of soil was more important in this respect than the variety grown.

The packer usually controls the seed supply as well as the time of harvesting. From the standpoint of harvesting costs, as well as the effect on quality, uniformity of maturity is important. In the case of seeded crops, which must be harvested at the peak of maturity, as many as 8 to 10 plantings may be made, to mature throughout a possible 2-months harvesting season.

Harvesting at optimum maturity and prompt handling from field to freezer are of first importance in the production of a quality frozen food. Apart from the findings of chemist and bacteriologist, everyone who has handled fresh fruits and vegetables knows that there is a point in their maturity at which they are at their best for serving or cooking. This is the ideal point for freezing. This period of optimum quality is short. After harvesting, it can be prolonged to some extent by proper refrigeration. Generally speaking, a temperature just above freezing is best, but any lowering of temperature below the usual summer heat of the harvesting season is helpful.

James A. Berry, addressing a California Frozen-Pack Conference, made the following statement:

"Tests show that more organisms, and therefore more fermentation or decomposition, occurred in six hours in a sample of strawberries held at 90° F. than in one at 40° F. held 42 hours; also that six hours delay at 90° F. is nearly as objectionable as 24 hours delay at 70° F. In shelled peas it has been found that at 70° F., bacterial growth is slow for a few hours, but that after that it is very rapid, while at 32° F. no significant changes occur even up to 48 hours."

Donald K. Tressler says, in an article in *Food Industries*, June 1938:

". . . there must be no delays at any time or vegetables will quickly lose their quality. During hot weather especial care must be taken to handle the products at the maximum possible speed. Sweet corn begins to lose quality the moment it is picked. Its goodness is not stabilized until it has reached 0° F., and then only if it has been properly blanched. Sweet corn allowed to remain in piles or sacks overnight in warm weather may lose half its sugar content. Vined peas and lima beans deteriorate exceedingly rapidly if allowed to stand in a warm place."

The blanching or scalding of vegetables for freezing cannot be considered as a sterilizing operation. Dr. Paul W. Allen, Professor of Bacteriology, University of Tennessee, in his paper, "Bacteria, the Friends and Foes of the Food Industry," presented at the Food Preservation Conference in Knoxville, October, 1938, stated:

"We have learned, however, that exposure of foods to the temperature of boiling water cannot be depended upon as a method of complete sterilization. Some microbes can withstand the temperature of boiling water for as long as six hours. Considerable human disease and great amounts of food spoilage have occurred due to the lack of appreciation of the ability of certain microbes to withstand exposure to heat. The facts about botulism illustrate these statements."

Reports of research workers in the frozen-food field agree with him. While blanching will reduce the bacterial count, it will not destroy all bacteria; and the moist, partially broken-up tissues are fertile fields for multiplication of the bacteria remaining, or which may be acquired from the air or contact surfaces in the plant. Neither are fruits and vegetables sterilized during the freezing process; and the surviving micro-organisms will start to multiply at a too high storage temperature or after defrosting in the home.

If frozen-food packers do not govern themselves in this matter of bacteria control, stringent regulation will be forced upon them, not only by Federal authority, but by the various health departments in the localities where the frozen food is sold. From a commercial standpoint, the distribution of "queer-tasting," off-color products, even if harmless to health, certainly will do the industry a great deal of harm.

VITAMIN CONTENT OF QUICK-FROZEN FOODS

The increasing consumer concern with the vitamin content of food lends interest to the claims of frozen-food processors and distributors that their products equal—in fact, usually excel—the fresh-market product in vitamin content. There seems to be little doubt of the superiority in this respect of properly frozen foods when compared with the average canned product. Considerable research has been done on the subject, including the interesting work under the direction of Dr. C. R. Fellers of Massachusetts State College. In a letter to the author Dr. Fellers writes:

"It is difficult to make a statement which is true under all conditions relative to the retention of vitamins in frozen foods. In general, we can say that the vitamin A, which of course comes from the carotene content of vegetables and fruits, is injured practically not at all by freezing. We have very little information as to vitamin B1 except that we know frozen foods still retain liberal amounts of this vitamin in the frozen condition. Freezing itself probably does not destroy more than 10 percent of the vitamin C in most vegetables, although storage, blanching, dilution and miscellaneous operations may cause losses running more than 50 percent.

"Of course the vitamin C is retained better in the more acid products. Naturally frozen foods should be used soon after defrosting, otherwise there will be a marked loss of vitamin C from the thawed product.

"Vitamin G is apparently stable to freezing."

Dr. Gerald A. Fitzgerald, Chief Chemist of the Birds Eye laboratories, in "The Effects of Freezing on the Vitamin Content of Vegetables," presented before the Food Preservation Conference, Knoxville, Tennessee, October 20, 1938, said:

"Vitamin C is recognized to be about the best index of quality because practically every factor that detracts from quality also lessens the vitamin C content of vegetables. Variety, over-maturity, soil and growing conditions, holding between harvesting and blanching, holding between blanching and freezing, storage and/or transportation at too high temperatures, and finally overcooking, all detract from quality and vitamin C potency of quick frozen vegetables."

If the vitamin C content is to be taken as an index of the quality of frozen food, it behooves the processor to protect the vitamin content of his product. In doing this, it appears from Dr. Fitzgerald's statement, the packer will be conserving the other characteristics which make for high quality. We may even see vitamin C content requirements a part of Government regulations applied to quick-frozen foods.

BLANCHING VEGETABLES FOR QUICK-FREEZING

One of the most important operations in the preparation of vegetables for freezing is blanching, or scalding, in a hot-water or steam bath. This is done to inactivate certain ferments, or enzymes, which otherwise would cause most undesirable changes in color, odor, and flavor during storage. Improper blanching will result in poor quality, regardless of the care with which the product is handled during the subsequent steps to the consumer. Many freezer-locker patrons have disputed this statement. They quote their own experiences with corn-on-the-cob, with peas and with other vegetables, which they did not blanch before freezing and storing in their lockers. Their sincerity cannot be questioned, but there are several possible explanations, the most probable one being that the products were used soon after freezing before serious enzymic action had occurred.

Blanching is limited to a minimum in order to avoid, as far as possible, a cooked appearance, and because long blanching destroys a greater percentage of the vitamin C content. But if blanching is carried on for too short a time, or at too low a temperature, enzymic action may start during storage and spoil the appearance and edibility of the product. If the center of the individual piece—of the corn cob, for instance, or of a mass of spinach or similar product—is not brought up to the requisite temperature, enzymic action will spread to the corn kernels, or throughout the package of spinach. Also different vegetables apparently require varying lengths of blanch.

Research authorities are not in agreement as to the exact time and temperature at which the different products should be blanched, although they do agree on the importance of blanching. Deterioration and spoilage of vegetables during commercial storage and in experimental work has indicated the need for additional research with regard to the best blanching times and methods, and investigations are being carried on by both private and public workers.

From the commercial standpoint, available and practical cold-storage temperatures determine the degree of blanch. That is, the blanch should be kept at the minimum to preserve, as far as possible, the original fresh condition and still be sufficient to assure the keeping quality of the pack when stored at an economical storage temperature. Many packers are working within a narrow margin in balancing their blanch against keeping quality in storage.

Fitzgerald, in his paper presented before the University of Tennessee Food Preservation Conference, said:

"A mistaken idea is prevalent that the commercial blanching process inactivates all enzymes. This is, of course, far from the truth. It actually inactivates only those which would spoil the merchandise during storage at 0° F. for a reasonable period—say a year."

One northwestern packer, using a continuous blanching and freezing operation, stated that they check the blanch by using the peroxide test every 10 minutes during the run. This test is made by placing broken pieces of the product in a test tube containing two or three teaspoons of hydrogen peroxide. The tissues should be broken from the center of the unit, where blanching is most likely to be incomplete. If no bubbling occurs in the solution, the scalding is considered sufficient. The efficacy of this test for all vegetables has been questioned by some authorities, and it is suggested that the latest findings by recognized authorities be consulted.

The canning industry blanches vegetables before the final cooking; but since the cooking would inactivate the enzymes without the need of blanching, the canner blanches for a different purpose—to expel gases from the products to aid in increasing the vacuum in the can, to prepare the tissues for absorbing more of the liquid in which the product is packed, and to facilitate packing into the can.

Fruits, with the exception of apples, are not blanched before freezing. They would lose their sales appeal as a fresh product, and in any event do not appear to need it. Various authorities attribute their apparent immunity from enzymic action to the admixture of sugar and to their acidity. Since it has been the custom for years to cold pack berries, especially red raspberries and blackberries, without sugar, and also there is the more recent sugarless single-frozen berry pack, it would seem that their acidity protects them.

Apple slices for pie bakers are blanched to prevent browning in some freezing processes.

GRADES AND STANDARDS

No generally accepted standards for the grading of fruits or vegetables for freezing could be located, except the specifications adopted by the Northwest Frozen Foods Association, March, 1939, for their frozen-pack strawberries.

The U. S. Department of Agriculture is working on standards for frozen products. On February 25, 1939, the Department issued tentative standards for frozen peas, and later for lima beans. These preliminary standards cover three grades—A, or Fancy; C, or Standard; and Off-grade, or Substandard. It is interesting that these standards require that the labels on the containers "shall comply in all respects with the requirements of the Federal Food, Drug and Cosmetic Act."

Until recently the quick-frozen fruit and vegetable industry has packed only one grade, presumably "Fancy." During the fall of 1937, institutional distributors who were handling one packer's line of high-grade products were in some instances selling another packer's line as a second and lower-priced grade. One eastern distributor had increased his volume of sales materially, since many of his customers would not pay the higher price for frozen foods. The cheaper product was not necessarily a second-grade quality, as some of his customers liked one as well as the other; and the objective was more a matter of price competition than of actual quality grading.

In 1938 Birds Eye began listing a "brown carton" pack of asparagus, string beans, lima beans, broccoli, and peas at lower prices than for the standard pack. This apparently was the first instance of a quick-frozen fruit and vegetable packer setting up standards for more than one grade. It is to be hoped that standards for all quick-frozen products will soon be adopted and rigidly applied.

Under present conditions the matter of standards practically narrows down to the individual packer's idea of a quality pack which he believes his consumers will accept. Since Birds Eye may be said to have established the quick-frozen food industry, especially the retail distribution, its products have been looked upon by many packers as representing standards to be met. When it is considered that quick-frozen food is a packaged product, ready for cooking or serving without further preparation; that it is susceptible to spoilage when exposed to above-zero temperatures; and is looked upon by many consumers as a luxury or semi-luxury food, the necessity for setting up high standards for grading and inspection is apparent.

After meeting the high standards for quick-frozen pack, the packer finds he has wholesome food left on his hands. When the quick-freezing operations are carried on in canning plants, the natural solution is to use these wholesome rejects in the lower-grade

canned goods. One eastern vegetable packer, who puts up both canned and frozen packs, cans the pea rejects from the frozen-pack line, producing, for the most part, a "standard" grade. All the lima beans received by this packer are frozen; but he separates the greens and whites. Asparagus rejects are cut and frozen for soup manufacturers.

SIZE GRADING

Fruit and vegetable packers have not followed canning practice in size grading, packing practically field-run, and eliminating only items too small for quality, broken, or otherwise undesirable, much as would be done in preparing fresh produce for the table. Canners are showing a disposition to pay less attention to size grading and more to color and flavor, possibly on account of the success of the frozen packs.

GRADING FRUITS FOR COLD-PACK FOR PROCESSORS

The specifications for packing cold-pack strawberries, adopted by the Northwest Frozen Foods Association, March 1939, divide the pack into three grades:

1. Graded Field Run strawberries means that the berries have been graded and all under ⅝ inch have been eliminated. A 5 percent tolerance for smaller berries is allowed.

2. Medium Graded strawberries means that all berries under ⅝ inch and over 1½ inches have been eliminated. A 5 percent tolerance is allowed for over and under size.

3. Large Graded strawberries means that all berries under 1¼ inches have been eliminated.

The price lists of one of the Northwest cold-pack selling organizations quote on three grades— small, ⅝ inch; field run; and large, 1¼ inches and up.

During the 1935 survey, northeastern preservers expressed a decided preference for strawberries graded within the range ⅝ to ⅞ inch. None of them professed to be getting berries graded this closely, and so far no commercial pack has been located which was graded within these limits. It was generally agreed that a strawberry smaller than ⅝ inch was usually poor in quality.

Mechanical graders were not used in the several southern and southeastern plants visited in 1937 and 1938, and grading on inspection belts was the rule. Many of the packs inspected contained berries smaller than ⅝ inch and the color was not always as uniform as it should have been.

In the sliced berry pack for the ice-cream manufacturer, there is no necessity for size grading except to eliminate those below ⅝ inch,

and the uniformity of color or maturity is not so important since the color of sliced berries tends to become uniform through juice absorption.

An inspector of eastern cold-pack strawberries who represented several preservers confirmed reports that he had refused to pass the product of one of the best eastern packers because this packer cut the tops of the berries in hand-capping and also used berries which were trimmed to remove green and overripe spots. This packer sells most of his product to the ice-cream trade, and such care in handling is to his credit; but the preserver wants a whole, uncut berry.

The Northwest Frozen Foods Association's specifications state that only one variety shall be packed in a container. A northwestern packer, however, said that he packed Marshall and "Marshall type" berries, explaining that the latter meant they mixed in Corvallis and Etterburg strawberries which had become too soft or were too large for canning.

With the exception of strawberries, there is little or no grading of fruits to definite sizes. Generally, grading and inspection entails the elimination of the very small, the immature, and the overripe, and, of course, any spoiled or otherwise unwholesome items.

One of the northwestern packers of a no-sugar pack of Cuthbert red raspberries in 30-pound cartons, had simplified his grading and other packing operations by delivering the cartons to the pickers, who filled the cartons as they picked, then closed and delivered them to the truck for transportation to the freezing room. Raspberries and similar berries are seldom washed before freezing. The fully ripe red raspberry is too tender to withstand washing without injury.

A pack of southern California Youngberries and Boysenberries, in 1937, was hand-graded after freezing. The berries were dumped on small slat tables just large enough for one man to work on each side. The sides and one end of this table were enclosed, the other end being open. The bottom of the table was composed of $\frac{3}{16}$- to $\frac{1}{4}$-inch slats spaced about the same distance apart. The men, wearing gloves, rolled the berries around on the slats by hand, picking out discards, leaves, and other foreign matter. Small matter and the berry "fuzz" rubbed off by contact with slats, gloves, and other berries, dropped through the slats onto the floor. In this "dry-cleaning" operation the berries were actually polished. The berries were gradually worked to the open end of the table and into paper-lined wooden boxes which were closed and made ready for storage. All of this cleaning, sorting, and packing took place in the storage room at 0° F. to 5° F.

Blueberries and cranberries usually are harvested by raking, and consequently are mixed with leaves, stems, and partly dried

and otherwise imperfect berries. Most of the light foreign matter is removed by a fanning-mill type of cleaner, after which the berries are hand-inspected and graded.

GRADING METHODS FOR FRUITS AND VEGETABLES

The observation, or hand, method of grading uses a moving inspection belt, which slowly passes the product before graders, who remove particles which do not meet the standards set by the packer. This method is widely used in grading strawberries for cold-pack, to facilitate removing underripe, overripe, and damaged fruit. The same method is used for separating green and white lima beans for separate packing.

Grading for size into two or more groups is done automatically by the use of perforated, vibrating belts or tables. For example, strawberries below ⅝ inch can be removed for discard and all above 1¼ inches can be shunted to a special pack.

The air-blast or fanning-mill separation is used where there is a decided difference in density of the parts, as in the separation of leaves or chaff from the product.

Products of relatively small differences in density are separated by immersion in a water or brine bath. Shelled peas, for example, when immersed in a brine of suitable density separate according to their maturity, the more dense over-mature peas settling to the bottom, while the lighter tender peas rise to the top. Several makes of automatic brine-density graders are now manufactured. Some evidence has been presented, however, which indicates a possibility that in all cases the density does not increase constantly as maturity progresses, but at some stage of maturity density may reach a peak and then decline. This theory is supported by the fact that over-mature peas are sometimes found with the tender "floaters."

MODERN FRUIT AND VEGETABLE FREEZING METHODS

As in other heat-transfer processes, freezing systems necessarily are based on transfer by radiation, conduction, or convection. The radiation method is illustrated by products placed in the still air of a sharp freezer; conduction, by the top and bottom metal contact of the Birds Eye multiplate freezer; and convection, by the flowing air of the air-blast tunnel freezer or the circulating liquid of the immersion freezer. In actual practice all freezing systems combine to some extent the three methods of heat extraction.

The freezing systems now in commercial use are of five general types:

Still air.—The product, either packaged or loose, is placed in low-temperature rooms, in trays which are stacked with spaces between, and left until frozen.

Forced-air circulation.—Tunnels and cabinet freezers, which use cold-air blast for freezing both packaged and loose products.

Contact.—The product, either packaged or loose in trays, is placed in direct contact with refrigerated surfaces. Examples:

Birds Eye Multiplate—top and bottom contact. Packaged products only.

Murphy—bottom contact—air circulated over top. Product may be packaged or loose in trays.

Sharp-freezer rooms—partial bottom contact. Products, packaged or loose in trays, are stacked on pipe coils. Fans may be used to circulate air around the products.

Spray of refrigerated liquid.—Packaged or loose products are passed through a refrigerated liquid spray, as in the "Z" process.

Immersion in liquid refrigerant.—Examples:

Finnegan tube juice freezer. Products packaged in sealed tin cans.

Immersion freezer developed at the University of Tennessee. Loose products are passed through a bath of liquid refrigerant.

Rotary freezer. Products are packed in sealed tin cans.

PACKAGED VERSUS LOOSE OR SINGLE-FREEZING

A number of distributors and institutional users interviewed during the survey expressed a decided preference for the loose or "single-frozen" pack of products, such as strawberries, peas and lima beans. Their main reason was the ability to break up large packages, and cook any desired quantity or fill "short" orders as needed. Housewives have expressed the same preference. Products frozen in the package usually reach the consumer in solid cakes which do

not divide easily, and the food units are mutilated by forced separation. Spinach, broccoli, and similar products, however, are generally packaged before freezing because they are difficult to pack without mutilation after they have been frozen. Likewise peaches, apple slices, and other fruits which oxidize quickly when exposed to the air and are usually packed in sirup, as well as sliced strawberries and other sugar- or sirup-packed fruits, must, of course, be packaged before freezing.

On general principles, the exclusion of air from contact with the frozen food is desirable, and the fact that the packaged product is frozen in a solid cake is advanced as a point for quality. This same argument is used in favor of the vacuum pack and the immersion and spray systems which coat the product with a thin protective film. It is pointed out that the solidly frozen packaged product is less affected by temperature changes in storage and transportation than the more loosely packed, individually frozen product. Perhaps the main advantage of the packaged-before-freezing method is the absence of dehydration from exposure to air during freezing. The designers of air-blast freezers have met the dehydration criticism by increased humidity in the freezing tunnel and shorter freezing periods.

CONTINUOUS PRODUCTION

Of the five general types of freezing systems now in use or being developed, the still-air and contact types are batch freezers and do not fit into continuous, straight-line production. The "Z" spray process freezer is used for either batch or continuous freezing. The forced-air tunnel freezers were developed on the West Coast for continuous production, and attention is being centered on improvement of mechanical means of conveying the material through the freezer and prevention of dehydration.

The Finnegan juice freezer, the rotary freezer, and the Tennessee immersion freezer are continuous freezers.

FREEZING TIME AND TEMPERATURE

It has generally been accepted that rapidity of freeze is essential for a good product, but there is no unanimity of opinion or practice as to the time or temperature which produces the finest product. The fact that products frozen under widely different conditions have proved commercially acceptable indicates either that there is some leeway possible in commercial operation without seriously affecting quality, or that consumers have not become sufficiently familiar with the various brands of frozen food now being distributed to recognize fine quality distinctions.

All of the freezing methods, with their many variations, now in commercial use have their proponents. Naturally, if a packer did

not believe in the methods he uses he would not have adopted them. Distributors and users of products frozen by widely different methods have maintained that the products were of equal quality. One eastern distributor, for instance, who sells the institutional trade a high-grade line of frozen vegetables of both the eastern packed-before-freezing and the western loose-frozen type of pack, said it had been his experience, and that of his customers, that one method was as good as the other, provided the same grade of material was used to start with.

No records could be located of any commercial comparative tests of the different freezing methods, in which identical products were handled in exactly the same way from harvesting to freezing. There is little to be gained by comparing a Thomas Laxton pea, grown in Maine and frozen by one method, with the same variety grown in Oregon and frozen by another method. Different climatic conditions, soils, fertilization, and processing procedures enter in, any one of which may affect quality as much or more than the freezing method used.

AIR-FREEZING SYSTEMS

With the exception of Frosted Foods Sales Corporation's operations in Oregon, in which the Birds Eye multiplate freezer is used, practically all the important West-Coast packs of frozen fruits and vegetables are frozen by air applied in various ways as a refrigerating medium.

Still-Air Freezing

Still-air freezing in its simplest form, has been used for several years for cold-packing fruits in the Northwest and other packing sections. The products, packed in barrels and other containers, are simply placed in the low-temperature freezing or storage rooms and left there until they are frozen. Improved practice rolls or turns the barrels during the freezing period to distribute the sugar and juice.

In another adaptation of still-air freezing, approximately 2,000,000 pounds of single-frozen Youngberries and Boysenberries were frozen in the available sharp-freezer rooms of a large cold-storage warehouse. The fruit was brought from the field in trays, in which the berries were not more than three layers deep. These trays were stacked on spacers in sharp-freezer rooms, held at -20° to -25° F., and the fruit was frozen in 3 hours or less. When facilities became overcrowded, freezing was hastened by placing electric fans in the rooms to keep the cold air circulating through the trays.

Similar methods of freezing were found in use in Oregon and Washington and in British Columbia, for both single-frozen and packaged fruits and vegetables. In some operations trays of produce, either loose or in packages, were placed between stacks of refrigerated coils in a sharp-freezer room. Air circulation was provided in

some instances by floor or ceiling blowers. In other installations, there were no refrigerating coils in the freezer room—all the chilling being done by low-temperature air blown in from outside the freezing room.

About every possible combination of air-freezing methods was found in operation, with strenuous supporters of the quality of the products frozen, and the economy of each method.

One California packer of fruits and vegetables used a simple cabinet freezer capable of temperatures as low as -40° F. The products, placed on metal trays, were loaded on shelves in the freezer. The freezing time was about one hour. The freezer was used for both loose and packaged goods.

Continuous-Air-Blast Freezers

The term "tunnel" when applied to bake ovens and furnaces generally means a long insulated chamber through which material is passed for heat treatment, usually by means of a traveling conveyor. The name appears to be rather loosely applied to freezers in the Northwest. In several instances it was used to describe enclosed space in a sharp-freezer room in which goods were stacked on racks with a blower to circulate air over and around them. "Continuous freezer" might be a better term to apply to freezers through which products are handled by means of a continuous conveyor; and this would more nearly conform to the terminology used for similar constructions in other industries.

A great deal of experimental and development work has been done on the tunnel, or continuous freezer, particularly on the West Coast, where many packers consider this type of freezer essential to large-volume continuous production. There are, of course, many ideas as to how it should be constructed and how the air should be controlled and applied.

The products are fed from the sorting table onto a wire-mesh belt ranging up to 7 feet in width. The speed of the belt and the temperature of the air blast are adjustable, so that freezing will be completed by the time the products reach the unloading end of the freezer. Products that are usually loose-frozen and then packaged, as well as products that must be packaged before freezing, are frozen in these machines.

In order to secure large-volume production, some of the machines had belts as long as 100 feet. Some operators said these belts were "balky," because of their length, and had a tendency to "freeze up," because of the moisture from the product.

At least one of the packers solved the problem of the long belt and excessive floor space by dividing the belt into two parts—one

placed above the other—the lower one acting as a return belt. There was only one door to the freezer for both loading and unloading. At the time of the visit to the plant the freezer was being used for loose-freezing cut corn, which was delivered direct from the blancher at a temperature of about 180° F. and was frozen in 18 minutes by an air flow of 41,000 cubic feet per minute at a temperature of -7° to -10° F. Earlier in the season it had been used for a large pack of peas and had a capacity of 3000 pounds per hour.

This packer has added a second continuous freezer but of different construction. Wire-screen trays, approximately 3 by 4 feet, are loaded with packaged goods and carried through the freezing tunnel by power-driven chains. The freezer is 40 feet long, has an inside width of about 4 feet, and is rated at 1½ tons per hour when freezing 2-pound cartons, which require 1½ hours to freeze. The 5-pound cartons require approximately 2½ hours.

One air-blast freezer used in Oregon had a continuous conveyor approximately 43 feet long and 7 feet wide. The 6-inch flights were made of woven wire, about ¼-inch mesh, which allowed air circulation through the belt. A distributed air blast at a temperature of -25° F. was applied both from above and below the conveyor. Cut beans were frozen during a 25-minute travel, and strawberries in 15 minutes. The frozen products were automatically dumped onto a small canvas conveyor which carried them to the packing tables.

The main criticism of the air-blast method has been that it results in serious dehydration of loose products during freezing. Designers of air-blast freezers have been working toward a low-temperature rise, or temperature "split," to give a higher relative humidity of the working air and reduce both the dehydration of the product and the excessive frosting of the refrigerating coils. This type of freezer has been operated with a temperature spread of only 3 degrees in the air entering and leaving the tunnel, and the contention is that by this close spread and by even distribution of the air, dehydration is avoided and the product crystallized immediately; also that there is little frost accumulation on the bunker pipes. Another West-Coast development is a continuous-air-blast freezer of the multi-stage type. In this a continuous stream of cold aid is forced through a mesh conveyor, being directed alternately up and down by baffles. The air passes over refrigerated surfaces immediately before and after each passage through the conveyor, giving a series of short working steps instead of the conventional long single stage.

This method is also applied to "tunnels" in which racks of goods are placed. The air is carried through the tunnel horizontally instead of vertically, the same principle of a short air travel and a low temperature rise being used.

Batch-Rack Freezer

One of the many adaptations of the air-blast freezing tunnel is the "batch" type, in which racks loaded with the goods to be frozen are placed in the freezing compartment and then withdrawn when freezing is completed. This is not, of course, a continuous operation.

Temporary Rack Freezer

An interesting design of the batch, or rack, type of air-blast freezer in the Northwest consists of uninsulated ply-wood cabinets erected in the low-temperature cold-storage rooms. Each cabinet has its own refrigerating, control, and air-circulating system, but as the cabinets are operated at nearly the same temperature as the air in the room in which they are placed, no insulation is required. The refrigeration and other equipment is permanently mounted on the walls of the cold-storage room, but the cabinets themselves are easily removable so they can be taken down at the end of the packing season and the space used for storage of frozen products. Three of the cabinets had a combined freezing capacity of about 2 tons per hour.

Continuous-Rack Freezer

A freezer recently installed in California uses loaded racks, but continuous operation is effected by carrying the racks back and forth through the freezing chamber by means of an overhead power-driven monorail conveyor. The racks have a total travel of about 350 feet, and the speed of the system is adjustable from the time required to freeze unpackaged peas, up to 4½ hours for some packaged goods.

BIRDS EYE FREEZER

The Birds Eye freezer consists of a cabinet equipped with refrigerated metal plates, placed one above the other in such a manner that they can be moved apart to receive packaged products between them, and then closed upon the packages with any desired degree of evenly distributed pressure. Packages of varying thicknesses may be frozen at the same time between different sets of plates. The cabinet is insulated so that the freezer may be operated in a room of ordinary temperature. Each freezer is self-contained and portable, and may be moved from one packing location to another. The aluminum alloy plates have internal passages for the uniform flow and distribution of the refrigerant. Freezing is done by direct expansion of ammonia, normally at a temperature of -25° F.

Before the machine is loaded, the plates are cooled until they begin to frost. After loading, pressure is applied to the stack of alternate layers of packages and refrigerated plates, so that at both top and bottom the packages are under pressure contact with a refrigerated plate. The freezing time varies with the thickness of the package, as well as the kind of product. Two-inch-thick packages of

fish and meats are frozen in about 90 minutes, while fruits and vegetables require about 2 hours.

This method of freezing is covered by several patents and is used exclusively by the Frosted Foods Sales Corporation (Birds Eye). All products are packaged before freezing.

"Z" PROCESS

The "Z" process was first developed in Europe by M. T. Zarotschenzeff for freezing unpackaged fish. It has been further developed in the United States, and is being applied to the freezing of other products, including fruits and vegetables. The freezing is done by the application of a fog or spray of low-temperature salt brine or other liquid having a low freezing point.

Products are frozen by this process either before or after packaging, depending upon the nature of the product and the type of spray used.

Freezers are built in three types:

1. The cabinet freezer is an insulated cabinet, with one or more compartments, in which the products to be frozen are placed on wire-mesh trays.

2. The truck type consists of an insulated chamber, into which an entire loaded truck, or rack, is placed at one time. This construction requires less labor and time in loading and unloading the freezer than the cabinet type. The rack is loaded at the packing table, ready for handling as a unit through the freezer and into the storage room.

3. The conveyor-type freezer consists of an insulated tunnel through which travels a continuous wire-mesh belt, or conveyor, and is adapted for continuous freezing.

Relatively high temperatures are reported used in the "Z" process. An invert sugar sirup is used at 10° to 12° F. for unpackaged or single-frozen fruits; and for vegetables, a salt-and-sugar spray at 6° to 10° F. For some vegetables and all packaged goods straight brine at -5° to 0° F. is used.

Corn on the cob has been frozen in 15 to 20 minutes, strawberries in less than 10 minutes, and sliced apples in 8 to 12 minutes, depending on the thickness of the slices. With -5° F. brine, 6-pound ducks are frozen in 2 hours and average-sized poultry in 1½ to 2 hours.

It is claimed that the brine remaining on the products is inconsequential, as the food can be rinsed with water and then packaged.

MURPHY SYSTEM

The Murphy freezer consists of an insulated chamber, containing several compartments divided by coils of brine pipe of rectangular cross-section so arranged as to form shelves one above the other.

The coils are placed close together to form a practically solid refrigerated metal bed, on which trays of the products to be frozen, either loose or packaged, are placed. The flat top of the coils affords a direct metal-to-metal contact with the bottom of the tray.

Blowers are placed at the end of the insulated chamber to insure more rapid freezing by keeping the cold air in circulation. In this way the products are frozen by contact from the under side and by cold air from the upper side. The circulating air passes over refrigerated cooling coils in the top and bottom of the cabinet. One eastern installation is reported to be using a temperature of -30 degrees F., providing a very rapid freeze. This system of freezing is limited to the cabinet type of construction and to batch loading.

IMMERSION-FREEZING SYSTEMS

Finnegan Juice Freezer

The California Consumers Corporation, in Los Angeles, the largest packer of frozen citrus juices, uses the Finnegan spiral-tube freezer. The juices are vacuum-packed in tin cans, which are continuously revolved as they pass through a metal tube containing a rapidly flowing, low-temperature alcohol solution, which surrounds the cans in the tubes. The juice is packed in various-sized cans which enter one end of the tube and are expelled from the other, effecting a continuous operation. It is reported that the cans are frozen at a temperature of -50° F., in about 15 minutes.

Tennessee Immersion Freezer

An interesting immersion-freezing method has been developed by the University of Tennessee Engineering Experiment Station in cooperation with the Tennessee Valley Authority. The object of the development was to effect a rapid freeze without subjecting the product to unnecessarily low temperatures, having in mind the cost and assumed quality advantages of freezing at or about the commonly accepted storage temperature of 0° F.

Fundamentally the machine consists of a conveyor, which carries the individual particles of the product to be frozen, through a circulating refrigerated solution. The efficient heat transfer due to the rapidly flowing cold liquid in intimate contact with small particles of the product, results in an unusually short freezing time at relatively high temperatures. With an invert sugar sirup at a temperature of from 2° to 4° F., strawberries have been frozen in 6 minutes. This is believed to be the quickest freezing method so far developed commercially.

Rotary Immersion Freezer

A recent immersion-freezer development on the West Coast is of special interest to the canning industry. Briefly, it is proposed

to insulate and otherwise adapt the present rotary cooker, widely used by canners, to the continuous freezing of vacuum-packed goods in standard tin cans. The freezer uses proved mechanical principles common to standard cannery practice, and the sealed cans are frozen in a solution having an ethyl alcohol base.

The test plant included such standard cannery equipment as a filling machine, a vacuum closer, conveyors, and elevators. The cans pass from an open-can sterilizer, through a filler, a vacuum closer, and the freezer to a packaging table and to storage. The freezer provides for a wide range in both time and temperature, and it is expected that commercial machines can be built for a speed of 120 or more cans per minute.

The designers claim a material saving in labor costs through a high output per man-hour, and that the compact design requires a small floor space as compared to other methods of freezing now in use. The ready adaptability of the machine to present cannery production lines and the use of much equipment already installed is expected to appeal to the canning industry.

Obviously there is no reason why products frozen in this way, in vacuum and hermetically sealed, should not be of the highest quality.

Water-Fall and Other Immersion Freezers

Another immersion-type freezer, referred to as the "water-fall" freezer, has been discussed in the West. It is proposed to flow the chilled liquid over the product by gravity, doing away with the small nozzles used for atomizing the liquid as in the "Z" freezer. The possibility of flowing low-temperature oil over goods packed in sealed cans has been considered.

CUSTOM FREEZING

Many packers, especially on the West Coast, have the choice of installing their own freezing facilities or taking their products to a cold-storage warehouse for freezing and storage. A West-Coast cold-storage company installed an efficient air-blast tunnel freezer in one of its plants, together with complete equipment for the preparation of the product. All products were put into a precooling room as soon as received at the plant and put through the freezer in order of delivery.

The Company stated that its experience with this first freezer was so successful that it planned to proceed with similar installations in its other cold-storage plants, including blanching and other preparatory equipment. All products and packing materials, as well as preparation and packing labor, were furnished by or for the account of the packer. An over-all charge was made covering packing space, freezing, and the first month's storage.

A similar plan of custom freezing has been placed in operation by an eastern cold-storage company.

PACKAGING FROZEN FOODS

COLD-PACK FRUITS FOR PROCESSORS

The bulk of the cold-pack fruit production is packed in 50-gallon paraffined wooden barrels, with some use of 30-gallon barrels and smaller kegs of various sizes. The 30-pound tin leads for medium-sized packages; with 15-, 10-, and 5-pound and No. 10 tins varying in relative importance from year to year.

The "single-frozen" berry pack on the West Coast is packed in fiber shipping cases, No. 6 cannery cases, and wooden western apple boxes with waxed-paper linings, as well as in 30-pound tins which hold about 20 pounds when used for "single-frozen" pack.

An eastern packer of the single-frozen type of pack uses a special heavy waxed fiber case holding about 20 pounds. He claims that this case prevents dehydration during storage and that the product is better than when packed in less protective containers. Cleaned, capped, single-frozen-type fruit is largely replacing the crate-frozen berry for the pie industry; and, while loss of moisture is not in itself objectionable for pie work, the resulting loss of bright color and flavor is, and the moisture-vaporproof containers probably will prove worth while.

In its early days this industry had to use the containers which were available, and keen competition has necessitated keeping packaging costs down; but it undoubtedly will profit from lessons learned in the quick-frozen food-packaging work and will replace containers which do not give adequate protection.

QUICK-FROZEN FOODS

The lack of standardization in the industry is nowhere more evident that in the packaging of quick-frozen foods. Attempts to develop a wide variety of containers to suit individual processing methods and practices have needlessly complicated the packaging situation.

Packaging is important to the industry from three angles: (1) protection of quality of product, (2) cost, and (3) sales assistance afforded by attractive and convenient containers.

In selecting containers, the quick-frozen-food packer considers the following points:

Protection of products:

- Strength, for mechanical protection
- Leak-proof for certain products
- Moisture-vaporproof materials
- Non-contaminating as to odors, flavors, or toxic effects
- Materials which will not affect color or quality

Durability, for strength and appearance
Adaptability to automatic filling and wrapping, for—
    Products packed before freezing
    Products packed after freezing
    Dry pack
    Liquid pack
Space economy in storage and transportation
Adaptability to existing distributing and retailing facilities
Labeling
Sizes
Cost
Consumer convenience and eye appeal

Two important requirements differ somewhat from those encountered in packaging other food products: (1) Materials must be moisture-vaporproof for protection from the dehydrating effect of the dry atmosphere of the zero-degree storage rooms; and (2) on account of the comparatively high cost of zero-degree storage, packages should be economical of space.

A block of ice placed in the dry zero-degree air of a cold-storage room will gradually disappear. It loses its substance in the form of vapor absorbed by the exceedingly dry air by which it is surrounded. To preserve this block of ice, it must be enclosed and hermetically sealed in a protective covering. Waterproof material is not enough—it did not disappear in liquid form—but materials called by the trade "moisture-vaporproof" must be used. The moisture content of unprotected frozen foods disappears in the same way. The desiccated solids which remain have lost flavor, color, and texture—all the attractive qualities of quick-frozen food.

Packaging Materials

The rectangular paperboard folded container, now widely used for both retail and institutional packs, is made of pure sulfite paper stock treated with paraffin. It is referred to in the trade as "manila," which is incorrect, as it does not contain manila. One carton manufacturer describes his material as "a solid groundwood sheet with a bleached sulfite liner on one side." Another stock has sulfite liner on both sides. The latter is white on both sides and is of better appearance but more expensive than the board with the single coating.

The carton blanks cut from the paper stock are treated with paraffin wax by either the "hot-wax" or the "cold-wax" process. In the cold process the blank is immersed in a molten-wax bath and then in cold water, which congeals the wax and prevents its penetration into the fibers of the board. In the hot process there is no sudden

cooling, and the wax is allowed to penetrate into the fiber. Critics of the hot process claim that it is liable to leave unprotected spots, and also that it gives a dull, unattractive finish, while the cold process gives complete coverage and a fine, glossy finish. Others favor the hot process and criticize the cold process as being greasy to the touch, which is disagreeable to the housewife. They say also that the finish has a tendency to pick up dust and dirt; and that the coating tends to come off during handling in the plant and cause difficulty in the wrapping machine. A criticism of both processes is that the wax is liable to develop hairline cracks when exposed to the low storage temperatures, and lose its moisture-vaporproof protective qualities. Both types of boxes are being used commercially, and with apparent satisfaction as mechanical protection for the product.

Various varnish and lacquer coatings are being experimented with, but up to the present time none have been used to any great extent.

When the cold package is subjected to normal atmospheric conditions the moisture in the air condenses on the cold surface; therefore the outer surface should be moisture resistant.

Usually the paperboard carton is a folded, unsealed box, which is neither waterproof nor moisture-vaporproof. When used with a moist pack, a sealed inner lining or bag must be used. This inner lining should be made of materials which are moisture-vaporproof as well as waterproof, and capable of retaining their flexibility under low-temperature storage conditions for long periods. Special grades of cellulose, vegetable parchment and sulfite paper, and lacquer-coated materials are offered for this purpose. These liners are generally used with dry packs also, although some packers depend on the outer wrap for complete moisture-vaporproof protection. The liners can be heat-sealed; that is, sealed solely by the application of heat. During the survey, heat-sealing operations were observed which employed electric curling irons, soldering irons, and flatirons, as well as the high-speed automatic sealing machines used in volume production

The packed carton generally has an outer heat-sealed wrapping, usually of waxed sulfite paper, or cellulose. A lacquer-coated paper also is being offered for this purpose.

Some carton manufacturers are offering a folding carton with an attached inner liner which can be heat-sealed, and they say that an outer wrap is unnecessary. This construction would have the advantage of allowing inspection without breaking the outer wrapper.

The various materials offered for moisture-vaporproof protection should be made the subject of unbiased tests as to their protective qualities. Such tests would be especially helpful in the selection of

wrapping materials for use in freezer-locker plants. An examination of the various commercial packs indicates that the majority of the commercial packers have standardized on moisture-vaporproof cellulose materials to protect the quality of their products against dehydration.

Rectangular Paperboard Cartons

The present rectangular, comparatively thin paperboard carton was adopted by Birds Eye as best meeting their conditions. The Birds Eye freezing system requires that all products be packaged before freezing, as they are frozen under pressure between refrigerated plates. A package with some flexibility is necessary, and it should be as thin as practicable so that the contents will freeze rapidly and uniformly. Although other freezing processes do not necessarily limit their users to this style of package, it has been generally adopted. In the freezing of packaged goods by any system a thin package is desirable, and all wet packs, and products which do not pack well after freezing, such as asparagus, spinach, and broccoli, are packaged before freezing. Many of the most popular products are loose-frozen before packaging, and for these practically any shape of container could be used.

There are many other good reasons, however, for the adoption of a rectangular paperboard carton. It can be shipped and stored flat, taking up little room. It is light and strong, and materials and methods have been worked out which provide ample protection for the product during storage. Its shape permits close packing in the shipping case, so that it meets the requirement for space economy in storage, transportation, retail cabinets, and freezer lockers. Estimates have been made which indicate that under some conditions, especially in retail cabinets and in freezer-lockers, as much as one-third more food can be stored in rectangular packages than in round containers. This will be an even more important consideration when frozen-food storage compartments are standard equipment for household refrigerators. The rectangular package is a convenient shape to carry home from market, and can be easily opened and disposed of—points appreciated by the housewife.

This does not mean the rectangular paperboard carton is the only or the best possible type of container for quick-frozen foods. The frozen-food industry is young; and now, before its standards have been established and too much equipment has been built, the packaging industry has an opportunity to develop new and better packaging procedures.

Carton Sizes and Weights

The industry has made several attempts to standardize on shapes and sizes of containers for the institutional and retail packs, but with little success. Standardization at present appears to consist

of a general acceptance of a retail container that will hold 12 ounces of frozen peas, using the same-sized package for other frozen foods but with varying weights of fill. Uniform-weight packs of 2½ and 5 pounds, with the dimensions of the containers varying to accommodate a definite weight fill of the different products, are in general use for the institutional trade.

Western Canner and Packer, in reporting its survey of the sizes of containers to be used in the 1938 pack, stated that the survey showed that many sizes of containers would be used. A container manufacturer was supplying eight of the leading northwestern packers, with a 12-ounce retail carton for peas, measuring 5¼ x 4 x 1¾ inches; a 2½-pound, 9½ x 5¼ x 2½ inches; and a 5-pound, 10 x 8 x 3 inches. One of the packers also puts up a 16-ounce retail package measuring 7¼ x 4 x 1¾ inches.

Another container manufacturer has made definite suggestions regarding dimensions of cartons. This concern suggested standardizing on a retail vegetable package 5¼ x 4 x 1¾ inches to hold 12 ounces of loose or single-frozen peas, which would provide an ample serving for the average family of four. This standard carton was calculated to hold the following weights of other vegetables:

	Ounces
Wax beans, broccoli, green beans, brussels sprouts	10
Peas and carrots, asparagus tips, green peas	12
Baby lima beans	13
Golden Bantam cut corn, spinach	14
Asparagus butts, asparagus butts and tips, cooked squash, Golden Bantam corn on cob	16

The 2½-pound carton as proposed, was to be 9¼ inches long and 6¼ inches wide, but of varying depths to accommodate a uniform net-weight fill of the various products. The depths suggested were as follows:

	Inches
Wax beans, broccoli, green beans, brussels sprouts	2-5/8
Peas and carrots, asparagus tips, green peas, asparagus butts, asparagus butts and tips, Golden Bantam corn on cob	2-3/16
Baby lima beans	2
Golden Bantam cut corn, spinach	1-7/8
Cooked squash	1-3/4

The dimensions suggested for the 5-pound carton were 10 inches long by 8 inches wide. The depths to accommodate a net-weight fill of the above products were 3½, 3, 2⅞, 2¾, and 2½ inches, respectively.

It hardly seems necessary to carry the uniform-weight idea to the extent of providing a special-sized carton for cooked squash, of which there was only an estimated 400,000-pound pack in 1937 out of a total vegetable pack of 70 million pounds—slightly over one-half of one percent. The products grouped for packing in the $2\frac{3}{16}$-inch and 2-inch, 2½-pound cartons, and the 2⅞-inch and 3-inch, 10-pound cartons made

up approximately 73 percent of the 1937 pack; yet it is proposed to use five sizes of cartons in each of the two capacities.

Of course these standard-weight packages would help the hotel steward to figure his servings accurately in ounces; but standard-sized dippers and not scales are used in serving the hotel and restaurant patron. Fresh peas are bought by the bushel, not by the weight of the shelled peas. Fresh strawberries and other fruits, bought by the crate or the bushel, vary in usable weight when they have been prepared and all waste and spoiled parts discarded. The institutional trade buys canned products in the No. 10 can, and there is no apparent reason why they should not buy quick-frozen fruits and vegetables in one standard package. If they become accustomed to buying frozen foods by weight, in packages of various sizes, it may be difficult to induce them to change.

At least one eastern vegetable packer apparently has started a movement to reduce the number of sizes for the institutional trade. He quotes on a 5-pound lima-bean carton, but specifies other products in the following weights:

	Pounds
Whole green and wax beans	3½
1½-inch cut beans	4
Frenched beans	5
Broccoli	4

This packer also quotes on "half-size cartons" holding respectively 1¾, 2, and 2½ pounds.

The University of Tennessee Engineering Experiment Station, in an experimental pack of individually frozen strawberries, Youngberries, and peaches, standardized on three units holding 1, 2½, and 5 pounds. Carton construction was standardized by the use of two dimensions common to all three sizes, so that it was possible to pack in a standard shipping case: six 5-pound, twelve 2½-pound, or thirty 1-pound cartons, or various combinations of the three.

Birds Eye uses a uniform "four-servings" retail package, but cartons for the institutional trade have a fixed length and width with a varying thickness to accommodate net weights of products of varying densities. The weights of the retail fruit and vegetable packs are listed as follows:

	Ounces
Raspberries, Youngberries, wax beans, broccoli, green beans, brussels sprouts, cauliflower	10
Blueberries	11
Green peas, peas and carrots, asparagus	12
Baby lima beans	13
Rhubarb, Golden Bantam cut corn, spinach	14
Apricots, peaches, prune plums, strawberries, cooked squash	16

This retail package is also used for clams, oysters, scallops, and crab and lobster meat. Other seafoods and meat cuts are wrapped individually and packed in 5- to 6-pound cartons, making it possible

to sell any desired number of chops or fish fillets. Ears of corn are wrapped in twos and fours instead of being placed in cartons.

The greater part of the Birds Eye institutional pack is in the 2½-pound carton. All the various kinds of fruit are packed in this size and sliced peaches and strawberries are also packed in 10-pound cartons. The only 5-pound packs listed are of green beans, peas, lima beans, and peas and carrots.

The advisability of packing only one size retail package has been questioned. All families do not consist of four people, and the same portions are not served in all households. The separate wrapping methods used for corn-on-cob, meats, and seafoods might be worked out to apply to other products. Some retailers purchase large institutional packages, from which the quantity desired by the consumer is dipped out and carried home in a paper bag. This return to "cracker-barrel" bulk selling is naturally not to be encouraged.

The canning industry, in its struggles with this same problem, has attempted to standardize on the No. 2 can for vegetables and the No. 2½ for fruits, for the retail trade, and the No. 10 for the institutional trade. In 1937, over 80 percent of the California cling peach pack was in No. 2½ and No. 10 cans, and nearly 80 percent of the vegetables packed in Oregon and Washington was in the No. 2 and No. 10 cans.

Canners have found it not only possible but necessary to standardize their processing equipment and procedures in order to use standard cans in straight-line production. There seems to be no logical reason why the frozen-food industry should not standardize to practically the same extent as the canners. There are no freezing systems now in commercial use, except the Birds Eye, which would limit standardization to any shape, size, or construction of the paperboard carton.

Labels

It has been general practice for the packer to put the label and all other printed matter on the carton itself, using a transparent overwrap. This requires a special run of the carton blank for each product, complicates ordering, stocking, and inventories, and adds materially to the carton cost. Some packers explained that they used the printed carton to prevent the marketing of their products under another name simply by replacing the outer wrapper. In the 1938 pack a trend appeared toward the use of a plain carton, with the overwrap as a label. This simplifies carton manufacture and cuts down the varieties of cartons which must be stocked by the packer. It also permits a more elastic allocation of the product either to the packer's or to a private brand at the time the pack is made or when it is withdrawn for shipment. If for any reason the label should have to be changed, it is much simpler to provide new overwraps than to re-

pack the goods in new cartons. The canner, as a rule, does not label his cans until they are packed for shipment.

This overwrap can be used, as is the can label, for attractive advertising, as well as for a descriptive label.

The question of inspection windows in cartons to aid sales promotion is frequently raised. The greater part of our packaged foodstuffs, including canned goods, are sold on faith in the label rather than by eye appeal. The two largest distributors of quick-frozen foods built up their distribution, using a blind carton and a non-display cabinet. Impartial sales tests should be made and careful consideration given to improving the appearance of the carton by more attractive overwraps rather than adding to the costs and complications of the present confused packaging situation by introducing another and more expensive type of carton.

Cylindrical Paperboard Containers

Various types of waxed-paperboard cylindrical containers, tubs, and cups are being used for frozen foods. They range in size from one-half pound to 10 pounds. They are offered as waterproof and moisture-vaporproof containers suitable for fruits, juices, and vegetables, and are used by at least one packer for oysters. They have the advantage of being set up ready for use, and require no assembling or wrapping in the packing plant. They do not pack closely in the shipping case or holding cabinet, and the unavoidable air spaces make the pack more susceptible to fluctuating temperatures during shipment and storage.

Some of the cylindrical containers are lined with a formed cellulose or other moisture-vaporproof sheet, with a sealed transparent top covering, permitting examination of the product by removing the paperboard cover.

Tin Containers

The possibility of packing quick-frozen food in tin cans cannot be ignored. Tin cans in various sizes up to 50 pounds are used for fruits packed for the processing and institutional markets, and in the institutional sizes for vegetables. In 1937, California vacuum-packed approximately three hundred thousand gallons of quick-frozen citrus juices in round tin cans. Experiments are being carried on in San Francisco with a continuous rotary freezer similar to the rotary cooker used in the canning industry, and it is proposed to use standard canning equipment for a vacuum pack in standard tin cans.

The hermetically sealed tin can is airproof, waterproof, and moisture-vaporproof. The support given by the rigid can in stacking, permits the use of cheaper shipping cases than are required for the paperboard cartons, which do not have sufficient strength to stand stacking, necessitating the use of a reinforced shipping case. On the

other hand, the round tin can is not as economical of storage and shipping space as the rectangular packages. Also there is some uncertainty regarding consumer acceptance on account of less convenience in handling, storing in refrigerators and disposing of empty containers. Objections have been raised to packing a perishable product in a sealed tin can on the ground of possible association with canned, non-perishable foods, which might lead to careless handling in the home.

PACKAGING COSTS

Processors' Packs

The cold-pack fruit industry in the various packing centers reported remarkably uniform costs covering the standard 50-gallon wooden barrel, which contains 450 pounds of the 2/1 strawberry pack. The average from a very narrow range of prices was $2.65 each, or approximately .6 cent per pound for the container. The cost of packing the graded cleaned fruit and the sugar in the barrel averaged .25 cent per pound—a total container and packing cost of .85 cent per pound.

The cost of 30-pound tins for cold-pack varied from 17 cents to 25 cents each, in different sections of the country.

The 2/1 strawberry pack in the 30-pound tin, including filling and handling labor, averaged approximately .85 cent per pound of pack. The single-frozen berries, packed without sugar to a net weight of 20 pounds per tin in one case, carried a tin and labor cost of 1.09 cents per pound.

A southern packer of single-frozen strawberries in 20-pound waxed fiber cartons reported a grading, handling, and packing cost of .15 cent per pound, exclusive of the container cost.

The 24-quart strawberry shipping crate, which was widely used by pie bakers for freezing fresh-market berries, costs, on an average, 30 cents. If it contains first-class fresh fruit, the 24-quart crate will cap down to a net weight of about 30 pounds, giving a container cost of about 1 cent per pound for the net usable fruit.

Institutional and Retail Packs

It is difficult to arrive at representative costs for packing in the rectangular paperboard cartons under present unstandardized conditions. The paperboard cartons now available are of almost every conceivable type of construction. They are shipped flat, with or without inner liner or bag attached to the blank. There are single blanks for setting up into a complete box, and there are separate blanks for box and cover. Some are adapted to machine set-up; others must be set up by hand. One carton manufacturer recently advised that 15 to 20 different types of construction were being used in va-

rious sections of the country—and there were at that time less than one hundred packers of quick-frozen foods. Other container manufacturers complain that there is no uniformity in styles or sizes used by the various packers. One manufacturer reported that his inquiries called for several kinds of board, two or three different finishes, many different styles, and a tremendous range of sizes.

The sellers' market conditions that have prevailed in the quick-frozen-food industry have allowed the packer considerable leeway in packaging costs; but with growing competition, the questions of costs and efficient methods of packing are becoming increasingly important. Unless package shapes, sizes, and materials are standardized to a point where mass production of containers permits low competitive costs, the industry may have to look for some other type of package.

At prices quoted for small quantities of containers of the type in general use, package-material cost per pound of sliced strawberries or peaches came to 2.35 cents. The same package would hold only ¾ pound of shelled peas, bringing the package cost per pound up to 3.13 cents.

For moderate quantities of 2½-pound fruit and vegetable packages for the institutional trade, prices quoted amounted to 1.54 cents per pound; and for the 5-pound package, to 1.25 cents per pound.

One large packer using the 2½- and 5-pound cartons of sulfite waxed paperboard, cellophane bag liner, and waxed paper overwrap, reported an average package cost of .7 cent per pound of product. He estimated the cost of setting up the carton, filling and sealing, at .4 cent per pound. This was for heavy-volume packing, peas alone amounting to about 1,500,000 pounds annually.

A relatively small single-frozen strawberry pack in 1-, 2½-, and 5-pound containers, using a waxed paperboard carton, cellulose inner bag, and cellulose overwrap, showed the following average costs, including shipping cases:

	Cents per pound
Cartons	1.03
Cellulose bags	.81
Cellulose overwrap	.234
Labor—folding boxes, packing, sealing, wrapping	.466
Packing case, material and labor	.86
Total	3.40

A packing cost of 3.4 cents per pound seems out of all proportion to the not unusual price of 5 cents paid the grower for capped strawberries. The same plant packed single-frozen berries in tins with lithographed covers, 20 pounds to the tin, at a material and labor cost of but 1.09 cents per pound. Many small concerns are packing under similar conditions.

PACKING COSTS

COLD-PACK FRUITS FOR PROCESSORS

Strawberries not only are the most important fruit packed for processors, but are of special interest to Tennessee. Particular attention was given to securing reliable packing-cost figures covering cold-pack strawberries. Costs obtained from various sources in the heavy Marshall strawberry-packing centers of the Northwest were in substantial agreement, as would be expected in an established, well-organized industry.

It is possible to make up the following typical break-down of the cost of cold-packing Northwest Marshall strawberries in an average year. The table covers the 2 1 strawberry pack in 50-gallon wooden barrels with a net weight of 450 pounds and containing 300 pounds of berries and 150 pounds of sugar:

	Cost per barrel
Strawberries capped, 300 lbs. @ 6c	$18.00
Sugar, 150 lbs. @ 5c	7.50
New 50-gal. wooden barrel	2.75
Hauling packed barrel from plant to freezer	.75
Freezing and storage first month	1.25
Loading into cars	.25
Packing-plant labor	1.25
General overhead	.65
Brokerage @ 4% of selling price	1.80
Field-crate expense	.45
Berry-buying cost	1.10
Shrinkage	1.15
Total	$36.90
Cost per pound	8.2c

The above figures are based on a plant labor rate of 42½ cents per hour for women and 52½ cents for men.

Cost estimates from other packing sections of the country were in close agreement with the above figures. Berries usually cost the packers slightly less in the early shipping states, where the pack consists mainly of surplus and berries too ripe for the fresh market, and the wage rates are generally lower than in the Northwest.

The large volume of single-frozen southern California Youngberries and Boysenberries frozen for the pie trade were packed by a simple low-cost method. After freezing, they were sorted and cleaned and packed in either standard western apple boxes or in No. 6 cannery cases. The berries were not washed, and the packer had practically no investment in equipment. The cold-storage plant charged 35 cents per 100 pounds for space for packing, freezing, and storing for one month. One of the leading growers and packers said his cost for delivering the berries to the freezer; the covered box and liner; and labor for sorting, cleaning, and packing in the cold-storage plant was 1.25 cents per pound. A total of 1.6 cents per pound covered all costs from the field through the first month's storage.

QUICK-FROZEN FOODS FOR INSTITUTIONAL AND RETAIL TRADES

Because of the wide variation in packing-plant procedures, the figures which could be obtained on quick-frozen foods for institutional and retail trade are of little comparative value. Packers are reluctant to discuss their operating costs. The large packers who have standardized on containers and packing methods and who pack in sufficient quantities to have worked out representative packing costs in mass production, generally refuse to give out such information for publication.

One packer of a large volume of single-frozen peas reported his costs on the 100-pound basis as follows:

Pay grower for peas	$3.25
Plant labor	1.00
Hauling from field	.15
Viner foremen, etc.	.15
Waste in small peas, 20% shrinkage, etc.	.65
Foreman, office expense, water, etc.	.15
Hauling peas to freezer	.18
Packing expense at freezing plant	.40
Freezing and storage 1 month	.50
Space and miscellaneous expense at freezing plant	.50
Cost of package	.50
Interest	.05
Executive administration	.25
Brokerage	.44
Extra labor in plant	.20
Total cost per 100 pounds	$8.37

The labor rate in this plant was 42½ cents per hour for women and 52½ cents for men. In this case the peas were completely prepared for freezing and then hauled to the freezer, where they were packaged and stored after freezing. This report has been criticised as too low, especially the cost of package.

The operator of a plant, using the continuous-air-blast type of freezer, estimated that the total cost of processing and freezing a 20-pound case of single-frozen peas was about 6 cents per case. At a rate of 1 cent per kwh, the power alone, including the power for maintaining the cold-storage room at 10° F. or less, would average about 1.15 cents per case. The manager of a northwestern pea-packing plant, using an air-blast continuous freezer, estimated that his power consumption for freezing 100 pounds of peas was approximately 7 kwh.

A cold-storage company doing custom freezing made a total charge for the service of $15.00 per ton of product, including storage for one month, and a subsequent storage charge of $3.00 per ton per month. Packing space and facilities were provided for local packers who delivered their fruits and vegetables to the freezer and provided containers and packing labor.

PACKING-PLANT WAGE RATES

Table 11 gives a brief resume of the information received from individual packers during the 1937-38 survey. These wage rates apply to the 1937 pack.

TABLE 11—*Packing-plant wage rates.*

Location	Type of packing	Wages	
		Women	Men
		Cents	Cents
Alabama	Cold-pack strawberries	25 per hr.	30 per hr.
Louisiana	" " "	20-25 " "	30-35 " "
Florida	" " "	15 " "	18-35 " "
"	Capping strawberries	1½ per qt.	
"	Canning and cold-packing	20 per hr.	25 per hr.
California	Olive	33-1/3 " "	40-60 " "
"	Cooperative fresh-fruit packing:		
	Packing fruit		7 per box
	Box-machine operators		72½ per hr.
Oregon	Cold-pack strawberries		35 " "
"	Quick-freezing fruits and vegetables	40 per hr.	50 " "
"	Cold-pack strawberries	40 " "	47½ " "
Washington	Miscellaneous fruit and veg. freezing	42½ " "	52½ " "
Utah	Vegetable canning	30 " "	40 " "
"	Cold-pack strawberries	22½ " "	35 " "
Iowa	Vegetable canning	32½ " "	35 " "
Michigan	Fruit canning and cold-packing	32½ " "	45 " "
Pennsylvania	Cold-pack fruits	35-40 " "	40-55 " "

One of the Seattle packers of frozen fruits and vegetables stated that on account of union activities his 1936 wage rates of 27½ cents per hour for women and 40 cents for men were increased to 42½ cents for women and 52½ cents for men in 1937. Because of equipment changes and increased volume of production, the increase in wage rates had not increased his labor cost per pound of product.

As will be seen from table 11, there is some variation in Oregon wage rates. The 35-cent rate was reported by a small packer located in a small town; the 50-cent rate was paid in a quick-frozen fruit and vegetable plant, using unusually high-grade workers in putting up a fancy pack. The general quality of pack, type of equipment, and class of worker were comparable, in the Oregon plant paying 50 cents and in the Florida and Louisiana plants reporting a maximum of 35 cents, and engaged almost entirely in putting up a high-grade pack of cold-pack strawberries. It is reasonable to conclude that the 1937 wage rates in the Northwest, at 47½ to 52½ cents, are comparable with a maximum of 35 cents in the Southeast, when on the same basis as to quality of pack, equipment, and class of worker.

PREPARATORY LOSSES IN PACKING FRUITS AND VEGETABLES

A large packer in the Northwest had records showing the percentages of materials bought from the grower which were actually packed and quick-frozen. This packer puts up a high-grade pack of several kinds of fruits and vegetables in paperboard cartons. The plant losses (table 12) include those due to grading, necessary trimming, loss of weight in pitting and peeling peaches, and cob and husk loss in preparing cut corn for freezing.

TABLE 12—*Preparation losses—fruits and vegetables.*

Product	Net yield in final pack
	Percent
Marshall strawberries (capped)	95
Peaches	80
Cuthbert red raspberries	95
Youngberries	95
Peas (shelled)	90
Spinach	40
Asparagus	60
Wax beans	90
Green beans (Kentucky Wonder)	90
Sweet corn (Golden Cross)	20-25
Broccoli (Green Italian)	60
Squash (Hubbard-Golden Delicious)	75
Cauliflower	30
Brussels sprouts	75

The figures covered by table 13 admit of some comparison between the preparatory losses in packing quick-frozen foods and in canning similar foods. The U. S. Department of Agriculture, in the 1936-37 study of price spreads between the farmer and the consumer, gives the following average required weights of various products as received from the grower, to fill standard-sized cans.

TABLE 13—*Farm equivalent weights—vegetables.*

Product	Can size	Farm equivalent weight
		Pounds
Corn	No. 2	3.2
Peas	No. 2	.877 (14.03 oz.)
Green beans	No. 2	.88 (14.08 oz.)
Asparagus	No. 2	2.19
Peaches	No. 2½	1.87

From other sources the following information has been obtained concerning farm-equivalent weights in canning:

Some of the best canners use from 80 to 85 pounds of cherries, as delivered by the grower, to pack 12 No. 10 cans, while others run 95 pounds or higher—a range from 6.66 pounds to 7.9 pounds to fill a No. 10 can.

One corn canner obtained 600 No. 2 cans per ton of corn in the husk as purchased from the grower. Another canner obtained 733

cans the same year, but only 680 the previous year; the extremes being 2.72 pounds and 3.2 pounds of corn in the husk to fill a No. 2 can.

Canners of green beans figure on securing 24 No. 2 cans from 20 pounds of beans as purchased, or .834 pound per can. Wax beans pack heavier and require about 26 pounds to fill 24 No. 2 cans, or 1.08 pounds per can.

A California test showed that it required 8000 pounds of asparagus as delivered to fill 4320 No. 2½ square cans, approximately 1.85 pounds per can.

A Wisconsin canner advised that he required an average of 15 ounces of shelled peas as purchased from the grower to fill a No. 2 can; but a member of a large statistical organization commented that the national average was about 17.7 ounces.

An important research laboratory connected with the canning industry supplied the data for table 14, showing average net fill-in weights of various blanched products as packed in No. 2 cans.

TABLE 14—*Average net fill-in weights, blanched vegetables.*

Product	Average fill-in weight
	Ounces
Lima beans	13.08
Corn, cream style	16.48
Corn, brine-pack	13.00
Peas	12.55
Cut beans	12.00
Whole beans	11.50

From the average fill-in weights of table 14, and the farm-equivalent weights, of table 13, it is possible, in the case of a few products, to calculate the percentage of purchased products that actually enter the can, and compare the results with the figures supplied by the northwestern frozen-food packer, as given in table 12. The comparison is as follows:

Product	Purchased	Packed	Final pack	Reported for freezing
	Ounces	Ounces	Percent	Percent
Peas	14.03	12.55	89.5	90
Sweet corn	51.2	13-16.48	25.4-32.2	20-25
Green beans	14.08	11.5-12	81.8-85.4	90

Such figures can be applied only in a general way, as the actual yield of processed goods will be affected materially by the quality of the produce and the grading and handling methods of the individual packer. This is well illustrated by the previously mentioned yields of the cherry and corn canners.

COMPARISON OF QUICK-FREEZING AND CANNING COSTS

The sudden and rapid growth of the quick-freezing industry, particularly the packing of vegetables, and its increasing competition with the canning business, has developed interest in the relative processing costs of the two methods of food preservation. To date there has been no adequate answer to this question. Our efforts to secure satisfactory cost comparisons have been concentrated on the important pea pack. Not only is this pack important to both industries, but the packing operations are widely spread over the country and therefore appeared most likely to produce results in the way of actual cost information.

One of the largest pea canners gave us the actual total pea-canning costs of several of their plants for 1937. The costs per dozen No. 2 cans, including sales and advertising, ranged from $1.26 under normal crop conditions to $1.82 under short crop conditions. According to table 14, based on average laboratory determinations, the 12 No. 2 cans contained approximately 9.41 pounds of blanched peas. This would indicate that it cost this canner from about 13.4 cents to over 19.3 cents per pound of peas canned. According to other supposedly reliable figures covering the net fill-in weights of peas in No. 2 cans, these 12 cans would contain approximately 11¼ pounds of peas, which would mean the packer had a pea-canning cost of from 11.2 to 16.2 cents per pound.

Allowing for considerable error, these costs per pound do not appear difficult for the quick-frozen pea packer to meet. The northwestern packers quoted 1937 opening prices of quick-frozen peas, in retail cartons, at 14½ cents per pound, and were accused by many people in the trade of insisting on too high a profit for the good of the industry. The distributor of one of the highest-grade packs of quick-frozen peas on the market said that he paid one of his packers 10½ cents per pound for his 1937 pack.

A pea canner who specializes in a high-grade retail pack of peas, comparable in both variety and quality to peas used for freezing, made a rough estimate that his pack cost him 10 cents per pound of peas, including sales cost. This basis of cost is comparative to the 8.37-cent cost reported by a packer of frozen peas, which included freezing and one month's storage and brokerage. One of the larger pea canners stated that, assuming a price to the grower of 3¼ cents per pound for shelled peas, his cost in the can, including brokerage, averaged 8.88 cents per pound.

The National Canners Association pointed out that the cost of canning peas varied widely in the different sections of the country, and that they felt that in many sections the above estimates were about right. The Association's country-wide average for the 1937 pack, however, was between 6½ and 7 cents per pound of shelled

peas, canned as "fancy grade," including brokerage and loading in cars at the plant.

An operator who both cans and freezes vegetables and sells the asparagus rejects as "cuts" to soup manufacturers, reports that it is cheaper to freeze these "cuts" than it is to can them.

One packer engaged in both quick-freezing and canning peas explained his refusal to give us the information as being due to his desire to keep his competitors in the canning industry from finding out how nearly equal the actual costs of the two methods are. Another packer of single-frozen peas, who is familiar with the cost of canning peas, has been quoted as saying that in his opinion the cost of preparing and freezing single-frozen peas is about the same as that of canning, and that any increased expense would be due to the higher cost of storing and transporting the frozen product.

From the few and very general opinions given by writers and speakers, we judge that the prevailing impression is that the costs of growing and harvesting, together with packing-plant operations up to the point of freezing or placing in the cooker, are the same for the two methods of packing. The quality specifications and necessity for closer grading may increase raw-material costs for freezing. Where canning operations are carried on at the same time, wholesome discards from the frozen pack may be used for canning. The lack of standardization of containers and packing methods in the quick-frozen food industry makes it impossible to draw satisfactory conclusions regarding the actual over-all comparative costs of containers, filling, and packing. According to some opinions, the cost of freezing is less than the canner's heating operation. And finally, we have the previously quoted packer's opinion that only in storage and transportation do the costs of quick-frozen foods exceed those of canned goods.

PART IV.

COLD-STORAGE RATES IN LEADING FRUIT AND VEGETABLE PACKING AREAS

Table 15 shows the prevailing 1937-38 cold-storage rates for both cold-pack fruits and the quick-frozen or carton pack of fruits and vegetables in areas near the major packing centers.

This table indicates that the cost of storing a pound of quick-frozen fruits or vegetables for a year, in carlots, was as follows in each of the respective general areas:

	Cents
West Coast	1.8
Western New York State	1.44
New York City	2.16
Jersey City	1.8
Tampa	1.8

Except in New York City, the cost of storing a pound of quick-frozen strawberries, for example, for a year is approximately from 6 to 7 percent of the retail price of about 25 cents. This, of course, is higher than for the kind of storage necessary for canned goods, but the rate is not much higher per month than the cost of cooler storage for fresh fruits and vegetables packed in lugs, hampers, or crates.

There are various types of services other than straight storage being offered by cold storage companies to meet the demands in their areas. It will be noted that the rates for Salem and Portland, Oregon, quoted in table 15, include the use of a traveling air-blast freezer and packing space.

A cold storage company in Washington provides space for grading and packing the product at a rental of 25 cents per square foot per month and places the maximum charge at $1.50 per square foot during any packing season. The charge for handling individual packages, other than shipping cases, in and out of storage is 10 cents per 100 pounds.

TABLE 15—*Cold-storage rates in leading packing areas—car-lot frozen fruits and vegetables, 1937.*

Location	50-gallon barrels			30-pound tins			Cartons			Single-freeze	
	Fresh to freeze incl. 1 mo. storage	Received frozen—1st month	Subsequent storage per mo.	Fresh to freeze incl. 1 mo. storage	Received frozen 1st mo.	Subsequent storage per mo.	Fresh to freeze incl. 1-mo. storage	Received frozen 1st mo.	Subsequent storage per mo.	Freeze and 1 mo. storage	Subsequent storage per mo.
	Each	Each	Each	Per 100 lbs.	Per 100 lbs.	Per 100 lbs.	Per 100 lbs.	Per 100 lbs.	Per 100 lbs.	Per 100 lbs.	Per 100 lbs.
Hammond, La.	$1.25	———	$0.50	———	———	———	———	———	———	———	———
New Orleans, La.	1.00	———	.50	[2]$0.09	———	[2]$0.06	———	———	———	———	———
Los Angeles, Calif.	———	———	———	———	———	———	———	———	———	$0.35	$0.12½
San Jose, Calif.	———	———	———	———	———	———	———	———	———	.35	.15
Albany, Ore.	1.00	———	.40	———	———	———	———	———	———	———	———
Salem, Ore.	1.25	———	———	———	———	———	———	———	———	[3]15.00	[4] 3.00
Portland, Ore.	1.25	$0.60	.40	[2] .15	[2]$0.12	[2] .05	$0.50	$0.35	———	[3]15.00	[4] 3.00
Seattle, Wash.	1.15	.65	.35	.35	.30	.15	.35	.30	$0.15	.70	.15
New Westminster, B.C.	1.00	———	.50	.10	———	[2] .09	———	———	———	———	———
Salt Lake City, Utah	2.00	———	.50	.50	———	.10	———	———	———	———	———
Denver, Colo.	[1] .75	———	.50	———	———	———	———	———	———	———	———
Omaha, Neb.	———	.60	.40	———	———	———	———	———	———	———	———
Minneapolis, Minn.	0.92½	.70	.40	.27½	.22½	.12½	.27½	.22½	.12½	———	———
Rochester, N. Y.	0.97½	.75	.40	.27	.22	.12	.27	.22	.12	———	———
Georgia	———	———	———	———	———	———	———	———	———	———	———
Montgomery, Ala.											
Chattanooga, Tenn.	1.17½	.95	.70	———	———	———	———	———	———	———	———
Knoxville, Tenn.											
Alabama	———	———	———	———	———	———	———	———	———	.50	———
Tampa, Fla.	0.75	———	.50	.40	———	.15	———	.40	.15	———	———
New York, N. Y.	0.87½	.65	.50	.33	.28	.18	.33	.28	.18	———	———
Jersey City, N. J.	0.82½	.60	.45	.28	.23	———	.28	.23	.15	———	———

[1]Rate to be increased.
[2]Rate for each 30-lb. tin.
[3]Rate per ton. Includes receiving commodity at quick-freezer, delivery from quick-freezer to packing room, space for packing, and handling from packing room to holding room; all preparation and packing labor to be furnished by or for account of the storer.
[4]Rate per ton.

TRANSPORTATION RATES FOR FROZEN FRUITS AND VEGETABLES

Table 16, prepared by the Tennessee Valley Authority, Transportation and Industrial Economics Division, shows the freight rates, carload minimum weights, and standard refrigeration charges for frozen fruits and vegetables from various Tennessee points and from the leading packing points of the country, to the two major markets, New York and Chicago. The freight rates are under two classes, column A applying to berries only, and column B to other fruits and vegetables.

In arriving at the actual cost of delivering a pound of frozen product to the market, we have to take into account not only the rate in cents per 100 pounds but also the carload minimum weight, as freight has to be paid according to these minimum weights, regardless of the fact that the load may weigh considerably less than the minimum specified. According to the table, the minimum weights vary broadly in the three important general frozen-fruit and -vegetable packing areas. The entire Pacific Coast and Texas have a minimum of 46,000 pounds; the northern tier of states and down into Virginia, 30,000 pounds; while the Southeast generally has 40,000 pounds. The Southeast, however, on fruits other than berries and on vegetables, has a minimum of 30,000 pounds—the same as the northern tier of states.

It is difficult to approximate the net weight of product that can be placed in a loaded refrigerator car. The actual weight varies with the kind of product, methods of packing, and the shapes and sizes of the shipping containers, as well as individual ideas as to how the car should be loaded. A carload of mixed products recently shipped into Tennessee from the North, under a 30,000-pound minimum, actually contained but 27,000 pounds net weight of product. The Tennessee Engineering Experiment Station reports that in shipping its experimental pack of single-frozen strawberries in paperboard cartons it was able to load only 36,000 pounds net, but was required to pay transportation on 40,000 pounds. That Station estimates that if it could secure one of the 50-foot refrigerator cars it could load the car to about 51,000 pounds net and thereby secure all the transportation paid for. These figures are based on the use of the heavily insulated cars for shipping quick-frozen products.

The standard refrigeration charges include the use of 21- to 30-percent salt and are fixed, regardless of the load. The West Coast, having a uniform rate of $1.16 per 100 pounds to both Chicago and New York, can deliver to New York for only $19.50 more per car than it costs to deliver to Chicago. In all such transportation rate tabulations, many inconsistencies can be found, such as a refrigeration charge from Harlingen, Texas, to Chicago of $6.00 per car less than from Cleveland, Tennessee.

TABLE 16—*Freight rates, refrigeration charges, and carload minimum weights.*[1]

Fruits and vegetables, cold-packed and quick-frozen

Rates in cents per 100 pounds
(Carload minimum weight as indicated by reference marks)

From	To					
	Chicago			New York		
	A	B	C	A	B	C
Los Angeles, Calif.	[a]116	[a]116	$100.50	[a]116	[a]116	$120.00
San Francisco, Calif.	[a]116	[a]116	100.50	[a]116	[a]116	120.00
Portland, Ore.	[a]116	[a]116	100.50	[a]116	[a]116	120.00
Seattle, Wash.	[a]116	[a]116	100.50	[a]116	[a]116	120.00
Salt Lake City, Utah	[b]107	[b]107	78.75	[a]116	[a]116	100.50
Salt Lake City, Utah	[c]132	[c]132	78.75	.....	.....	.....
Fairmont, Minn.	[d]76	[d]76	71.25	[d]125	[d]125	93.75
Traverse City, Mich.	[d]50	[d]50	60.00	[d]84	[d]84	82.50
Rochester, N. Y.	[d]65	[d]65	75.00	[d]52	[d]52	60.00
Corinna, Me.	[d]95	[d]95	90.00	[d]66	[d]66	75.00
Norfolk, Va.	[d]83	[d]83	83.25	[d]52	[d]52	68.25
Tampa, Fla.	[c]120	[d]166	102.75	[f]92	[d]149	89.25
Tampa, Fla.	.....	.....	.....	[c]108	[d]149	89.25
Hammond, La.	[c]92	[d]127	90.00	[c]110	[d]152	120.00
Birmingham, Ala.	[e]77	[d]108	105.00	[c]95	[d]130	120.00
Harlingen, Texas	[f]110	[f]110	84.00	.....	[g]116	100.50
Cleveland, Tenn.	[c]76	[d]105	90.00	[c]86	[d]119	108.75
Chattanooga, Tenn.	[c]75	[d]103	90.00	[c]86	[d]119	108.75
Knoxville, Tenn.	[c]71	[d]98	90.00	[c]79	[d]108	108.75
Nashville, Tenn.	[c]61	[d]84	86.25	[c]93	[d]128	108.75
Dyersburg, Tenn.	[h]42	[d]78	86.25	[h]86	[d]126	108.75
Dyersburg, Tenn.	[c]57	[d]78	86.25	[c]92	[d]126	108.75

Description of rate columns:

Column A—Fresh berries, frozen, in till boxes in crates, in cartons in boxes, or in containers in boxes; berries, in water, or in their own juice, or sugared, when chilled or frozen, for preservation while in transit, in cans, or in bulk in barrels; in straight carloads.

Column B—Fresh fruits, frozen, in till boxes in crates, in cartons in boxes, or in inner containers in boxes; fruits, in water, or in their own juice, or sugared, when chilled or frozen for preservation while in transit, in cans, or in bulk in barrels; fresh vegetables, frozen solid, in cans or cartons, boxed, or in bulk in boxes; in straight or mixed carloads.

Column C—Standard carload refrigeration charges, including 21 to 30 percent salt.

Explanation of reference marks:

a. Carload minimum weight 46,000 pounds.
b. Carload minimum weight 60,000 pounds except on shipments in bulk in barrels, in straight carloads, when cars are loaded to full floor capacity, two tiers high. actual weight, subject to a minimum weight of 46,000 pounds applies.
c. Carload minimum weight 40,000 pounds.
d. Carload minimum weight 30,000 pounds.
e. Carload minimum weight 40,000 pounds except shipments in cans or in bulk in barrels, minimum weight 36,000 pounds.
f. Applicable only on fruits, berries and vegetables, frozen solid, carload minimum weight 46,000 pounds.
g. Applicable only on vegetables, frozen solid, carload minimum weight 46,000 pounds.
h. Applicable only on strawberries (frozen or not frozen), preserved in juice, sugar or sirup, in bulk, in barrels, carload minimum weight 36,000 pounds.
i. Applicable only on strawberries, carload minimum weight 40,000 pounds.

Tariff authorities: L. E. Kipp's 2-1, I.C.C. 1427; L. E. Kipp's 3-L, I.C.C. 1413; L. E. Kipp's 120-F, I.C.C. A-2566; L. E. Kipp's 230-A, I.C.C. A-2592; F. D. Miller's 249-D, I.C.C. 391; J. R. Peel's 199-H, I.C.C. 2989; B. T. Jones's 488, I.C.C. 2452, B. T. Jones's 490-A, I.C.C. 2767; I. N. Doe's 18-B, I.C.C. 369; I. N. Doe's 20-C, I.C.C. 362; R. A. Sperry's 15-D, I.C.C. 397; W. S. Curlett's 44G, I.C.C. A-608; W. S. Curlett's 60, I.C.C. A-330; W. S. Curlett's 72-A, I.C.C. A-445; W. S. Curlett's 107-B, I.C.C. A-593; Illinois Central R. R. Tariff 148-P, I.C.C. 8162; Union Pacific R. R. Tariff 6040-G, I.C.C. 3970; J. J. Quinn's Perishable Protective Tariff 10, I.C.C. 11.

[1]Table prepared by Tennessee Valley Authority, Transportation and Industrial Economics Division, May 31, 1939.

The rapidly increasing quick-frozen fruit and vegetable pack in the vicinity of Rochester, New York, is in a particularly favorable position to reach the New York City markets, with a freight rate of 52 cents, a minimum car weight of 30,000 pounds, and a refrigeration charge of only $60.00. Norfolk, Virginia, can reach New York on the same basis as Rochester, except for an additional refrigeration charge of $8.25 per car. Both of those packing points have a decided advantage over the various Tennessee points in the matter of transportation costs in reaching the New York market.

From table 16, assuming a possible net weight per car of 36,000 pounds, the actual cost per pound of single-frozen strawberries transported from each of the following packing points to New York, is calculated as follows:

	Cents
West Coast	1.83
Salt Lake City, Utah	1.76
Fairmont, Minnesota	1.51
Corinna, Maine	.87
Rochester, New York	.685
Norfolk, Virginia	.71
Hammond, Louisiana	1.55
Tampa, Florida	1.27
Knoxville, Tennessee	1.23
Cleveland, Tennessee	1.25
Nashville, Tennessee	1.33
Dyersburg, Tennessee	1.16

If the large refrigerator car is used, in which it is figured a 51,000-pound net load could be placed, the transportation cost to New York from the West Coast would be reduced to 1.39 cents per pound; from Knoxville, 1.05 cents; while Rochester, New York, would show only a minor decrease, to .638 cent.

In adopting particular sizes and shapes of cartons and shipping containers, it is well to keep in mind their adaptability to efficient loading in the refrigerator car, and thought should be given to the best method of loading to keep transportation costs at a minimum.

MEETING FROZEN-FOOD COMPETITION

Our 1937-38 survey found fresh-produce marketing organizations, especially on the West Coast, planning to meet frozen-food competition with better products for the fresh market. All phases of the industry were being studied—improvement of varieties, and harvesting and packing methods, as well as transportation and refrigeration practices. It was agreed that handling after delivery in the eastern terminals offered the greatest difficulties, as these operations were out of the control of growers' and distributors' organizations, and finally depended on the methods of the thousands of chain and independent retailers.

The introduction of cleaned, graded, and packaged fresh fruits and vegetables recognizes the demand for a better and more convenient product and is one method of meeting the inroads of quick-frozen foods.

The canners are also working toward better products. The tree-ripened fruit packs, particularly peaches and apricots, which are receiving an enthusiastic reception by consumers, were undoubtedly hastened, if not inspired, by the success of frozen fruits. Efforts by individual canners to improve both raw material and processing methods have been intensified, and concerted action has been reported, to develop revolutionary new methods with the object of producing canned products which would be comparable to quick-frozen fruits and vegetables.

In three general ways the established fresh-produce and canning areas can prepare for the competition of quick-frozen foods:

1. Improve present fresh-market products and methods of handling.

2. Improve quality of produce for canning and methods of processing.

3. Establish or increase quick-frozen-food operations.

The present quality and methods of handling fresh produce offer ample opportunities for improvement, especially in the growing areas within trucking distance of the large consumer markets. Better variety selection for flavor and texture; carefully harvested, cleaned, graded fruits and vegetables in attractive, protective packages; and keeping under proper refrigeration would go far toward meeting frozen-food competition.

QUICK-FROZEN POULTRY

The quick-frozen-poultry industry was not a specified subject of investigation, but in view of Tennessee's poultry production, it seemed advisable to include such information as was readily available. In 1937 Tennessee produced over 15,500,000 chickens, of which the producers sold about 47 percent, bringing in a cash income of over $4,000,000—about equal to the combined income from strawberries and all other truck crops for both manufacture and the fresh market, or approximately 3 times the income from peaches. It is an interesting fact that the North Atlantic states sold 89 percent of their production in 1937, while the South Atlantic and South Central states sold only 52 and 42 percent, respectively, indicating a heavy home consumption in the South.

The new frozen poultry has been known by various names: "eviscerated", "fully dressed", "fully drawn", "full-drawn", "pan-ready", and "kitchen-ready". "Ready to cook" is the name now used by the largest packing companies.

It is believed that Birds Eye originated this method of merchandising poultry for distrubution as one of its quick-frozen-food items. The poultry is full-drawn, ready-to-cook, packaged, and frozen. Birds Eye points out that in packing, 33 percent waste is eliminated in the case of broilers, fryers, fowl for fricassee, and ducklings, and 25 percent waste in roasters and turkeys. Apparently these waste savings are based on a comparison with plucked but undrawn, or so-called "New York style", poultry.

This method of marketing poultry began attracting attention in 1936, and consumer acceptance was so favorable that by 1938 many large packers had entered the business, mainly in the heavy poultry-producing and -packing states in the Midwest. Figure 9 shows the present locations of the leading packers of ready-to-cook poultry.

There are no statistics available as to the production of ready-to-cook poultry, but it is estimated that the quick-frozen food industry packed and distributed about 10,000,000 pounds in 1937. This is not an impressive amount when compared with the 123,000,000 pounds of frozen poultry holdings reported by the U. S. Department of Agriculture January 1, 1938. There are no indications as to how much of this was ready-to-cook, packaged poultry, but it is probable that the estimated 10,000,000 pounds of quick-frozen poultry was only a small part of the total ready-to-cook poultry pack.

A retailer who has no low-temperature storage cabinet may receive the product frozen and hold it for at least a week in a 40-degree refrigerator, handling it as he would fresh dressed poultry. The industry is appealing to the retailer with, "Any clerk who is capable of selling an ordinary package of any food product can sell pack-

aged drawn poultry." The large volume now sold in this way, usually as fresh poultry, is suitable for distribution as a quick-frozen product as soon as a wider distribution of low-temperature retail cabinets enables the retailer to store it properly.

If properly prepared, frozen, and stored at a sufficiently low temperature, this poultry is said to maintain its fresh-killed characteristics for at least a year. So far as known, its maximum storage period has not yet been determined. Fryers, ducklings, or turkeys may be killed at the proper stage of maturity, and kept fresh until wanted, the kitchen preparatory work all having been done in the packing plant. The turkey producers are hopeful that this method of marketing will extend their season from about 6 weeks around Thanksgiving and Christmas to the entire year.

There seems to be no doubt that this marketing of packaged poultry will affect the present poultry markets of many states, especially those now shipping live poultry. Not only will their out-of-state markets be affected, but in their local markets they will have to compete with this convenient, sanitary product.

The poultry industry now is rated a billion-dollar business and uses 25,000,000 containers each year, not counting 40,000,000 egg cases. Manufacturers of packaging materials for ready-to-cook poultry look forward to a potential market of 300 to 450 million birds per year, according to recently issued publicity material. The product certainly has sales appeal and meets the modern demand for sanitary ready-to-cook packaged food of high quality.

The packers generally are packing Grade A poultry only, and under Government supervision. The carefully selected birds are brought to the packing plant, where they are placed in batteries in large, well-ventilated and well-lighted rooms. They are scientifically fed for a period of one to two weeks. Birds Eye reports using a diet of fresh buttermilk, oats, flour, and other mill grains to produce plump birds and build up just enough fat to prevent dryness and loss of flavor during cooking. They make a point of the immaculate and sanitary conditions which prevail throughout, the white uniforms of the attendants, and freshly painted walls and floors, which suggest hospital cleanliness.

A poultry-packing plant in Omaha was one of the cleanest food-processing plants visited during the entire survey trip. The spotless white uniforms and stainless-steel equipment and the constant inspecting, grading, and cleaning of the birds, left no doubt as to the "hospital cleanliness" and the desirability of the product.

The greater part of the present ready-to-cook poultry pack is individually wrapped in cellophane or other moisture-vaporproof material. Much of it is sold through refrigerated retail meat cabinets

and the cellophane wrap makes an attractive display. It is closely wrapped to exclude all the air possible. Birds Eye applies a stockinette over the cellophane to secure closer contact, and the descriptive label is placed on the stockinette, ignoring the display advantage of the transparent cellophane wrap. For that matter, all Birds Eye quick-frozen products are sold in closed packages without any display of the product. The use of printed cellophane wraps for poultry is becoming more general, and the net weight and Government inspection tags are enclosed. The wraps are tied or stitched by special machine.

The birds are closely graded, according to weight, and usually packed 6 to a carton. Birds Eye packs 12 broilers or fryers per carton and 4 cartons to the shipping case, while larger chickens, ducklings and turkeys are packed individually. Complete handling and cooking instructions are wrapped with each bird. When the retailer does not have proper storage facilities and some of the birds thaw before they are sold, a small number to the carton is generally preferred, so that complete cartons can be delivered to the retailer without his having to carry too large a stock in order to secure a variety.

FREEZER-LOCKER PLANTS

Whether the first freezer-locker-plant operations started in a California ice plant in 1903; in Centralia, Washington, in 1917; or in any of the "original" locker-plant localities—all of them merely substituted mechanical refrigeration for Nature in preserving the hunter's game and the farmer's meat by freezing. Probably these "first" freezer-locker operations all were original in that they started spontaneously in response to a demand, without knowledge of similar freezing operations in other localities.

It is generally acknowledged that the Northwest developed the freezer-locker plant into a successful business, adding fruits and vegetables to the original game, fish, poultry, and domestic meats, with which the operations started. The idea spread east into the Mountain states, and reaching the heavy meat-producing states in the Middle West, developed rapidly for the freezing and preservation of domestic meats. A general expansion started in 1936, and since then freezer-lockers have spread to practically all parts of the country. The growth of freezer-locker operations has paralleled the expansion of the commercial quick-frozen food industry, both industries starting steady growth during a period of low buying power.

TYPES OF FREEZER-LOCKER PLANTS

The trade divides freezer-locker plants into two general classes—"limited service" and "complete service"—but there is no distinct dividing line. The limited-service plant in its simplest form is merely a low-temperature room fitted with individual lockers. The renters of the lockers do all the preparatory work, such as cutting and wrapping meat and preparing and packing fruits and vegetables. The food is placed in the locker by the renter and frozen there. In a few of the more primitive plants visited in the Northwest, there was little or no supervision of what went into the lockers or how it was packed. Unwrapped fish, hams, and sides of bacon, stacked in the lockers, glass jars of fruit which had broken in freezing and leaked into and through the lockers underneath, were not uncommon sights. Even in these plants practically all of the lockers were rented, and their owners often were planning additional lockers and better service.

In more progressive and later plants the operators watched carefully what went into the lockers, in the interest of the individual renter as well as his neighbors. The majority of them provided meat-cooling and -aging rooms and meat-cutting and -wrapping service, and purchased meats wholesale for their patrons if desired; aging, cutting and wrapping the meat for the usual fee.

Generally the limited-service plant was operated as an adjunct to some other business, such as a butcher shop, creamery, or cold-

storage plant. It was the general opinion in the Northwest that less than 500 lockers could not be operated economically as an independent business. In Tennessee and other parts of the East, small plants are being installed and operated by grocery stores. A freezer-locker plant operated in connection with the "general" store in the isolated crossroads village adds to the owner's income and offers many otherwise unobtainable services to his farm customers, as a means of storing both their home food supplies and their perishable products for future sale.

The modern complete-service plant is a well-organized and well-equipped food-processing and storage plant, with sufficient income from various sources to constitute a profitable independent business. The services which are offered range from picking up the live animal on the farm, butchering, chilling, aging, cutting up, wrapping, freezing in a modern quick-freezer, or smoking and curing, and placing in the locker—to delivering the frozen products back to the farm as required. For these services the locker patron pays a fixed price per unit or pound. Only a few plants offer all of these services, but the trend is toward an increase in service features.

Other parts of the country have lagged behind the Northwest in utilizing freezer-lockers for freezing and storing fresh fruits and vegetables. The locker operator leaves it to the initiative of the patron to prepare and freeze garden surplus or fresh produce purchased in season, and misses an opportunity to keep the lockers filled the year round. Full lockers increase the renter's satisfaction with his locker and lower the rental charges per pound. A few freezer-locker plants have installed equipment and prepare fruits and vegetables for freezing for their patrons on a fee basis or in some instances for a percentage of the finished product.

Proper packaging and protection from dehydration with moisture-vaporproof materials is equally as important for locker storage as in commercial work. Since the proper packaging materials are not now readily obtainable in small quantities and at reasonable prices, the locker operator should be prepared to supply suitable packaging materials when the preparatory work is done by the patrons. Instructions for preparing fruits and vegetables should be supplied. Home demonstration agents are adding assistance in preparing garden products for freezing, to their other home instruction duties.

In addition to purchasing meats, many locker operators buy commercial quick-frozen foods wholesale for their patrons for storage in their lockers, charging a brokerage fee for handling; others install a low-temperature cabinet and retail the frozen foods to patrons and the general public; and some operators do both. Trade reports of the convention of the Iowa locker association in the lat-

ter part of 1938, indicated that 90 percent of the members were selling or desired to sell a commercial pack of foods.

Many freezer-locker installations are in fact food-processing plants, processing and freezing local products, not only poultry, fruits and vegetables, but specialties such as frog legs and squabs. These plants are putting up commercial types of pack and have their own brand names for their products. The products are usually sold locally or to nearby markets. Their operations are of service to the surrounding agricultural area in that they serve as a nucleus or testing plant for more extensive food processing undertakings, as well as in their immediate ability to preserve and market surplus products.

OPERATION AND OWNERSHIP

Locker plants are owned and operated by cooperatives, individuals, partnerships and corporations. According to informed opinion, about one-quarter of the plants now in operation are owned by cooperatives.

Farmer cooperatives are more interested in meeting the needs of their members than in profits, although, of course, their plants must be self-supporting and profits are desirable. Cooperatives consisting of farmers and local business men are also interested in establishing locker-plants, especially if the plants are to be equipped for processing and storing local farm products. The main criticism of cooperative ownership seems to be management difficulties in having to depend on decisions by a board or committee in adding facilities or services, or making changes in operating methods, in contrast to the more elastic one-man management or ownership. The growing popularity of freezer-locker plants has attracted idle capital, and large, modern, full-service plants are being built in desirable locations, which are being financed by local or by outside capital or by a combination of the two. In some cases "chain" locker-plants have been started in neighboring centers, under a central business management.

In a few localities locker systems have been put into operation. A large complete service plant, in addition to serving its own locker patrons, performs the preparatory and processing services for several small branch plants which confine their operations to locker storage. These branch plants can be constructed and equipped at moderate expense and the main plant can more fully utilize its labor and equipment. This seems to be a practical arrangement, especially when the locker system is operated in conjunction with another business, such as a creamery which has milk- and cream-collecting stations.

OPERATING PERSONNEL

The early limited-service plants were often operated as adjuncts to some other business and under the management of the parent concern. A trained butcher was required for handling the meats, and he usually operated the plant, meeting and assisting the patrons in their visits to their lockers. A few of the larger plants were operated independently, usually by the owner, sometimes by the owner and his wife, with one or more butchers and assistants according to the number of lockers and types of service offered. The owners and operators in the Northwest have been fortunate in that so many commercial freezing operations are carried on within easy reach, where preparation and freezing methods can be observed. The Oregon State College pioneered in fostering locker-plant installations and assisting them in their processing and operating methods, as did the Washington State College. The U. S. Frozen Pack Laboratory at Seattle has been available for consultation and technical advice.

The freezer-locker plants in other parts of the country are seldom located near commercial freezing plants and do not have so many authoritative nearby sources of technical assistance. Various state colleges have published bulletins and studies of locker-plant problems which have been of invaluable assistance, but in the main the educational burden in most localities has fallen on the industrial concerns supplying the locker-plant material and equipment.

With the development of the modern freezer-locker plant into a food-processing and storage plant, offering its patrons any or all types of services, has come a need for operators experienced in food technology, especially in the new science of quick-freezing. At present there are no sources of trained personnel either for commercial plants or for freezer-lockers. If the installation of locker plants continues at the estimated present rate of 500 to 600 per year, measures will have to be taken to provide trained personnel. Otherwise we will have improperly operated plants resulting in deteriorated if not spoiled food and a set-back in the popularity and usefulness of freezer-lockers.

LOCATION OF THE FREEZER-LOCKER PLANT

The freezer-locker plant should be located within convenient reach of the maximum number of prospective patrons in the area it is intended to serve. Ample parking space for automobiles and trucks is essential. At the present time farmers are the largest source of patronage, but interest in lockers is increasing among town and city residents. In reaching a farm clientele, the size of the town in which the plant is located is less important than that it be a trading center for a prosperous farming section, with good roads leading out to the prospective patrons.

The renters in a 560-locker plant in an Oregon city of 30,000

population were two-thirds farmers and one-third city residents. Another locker plant located on the outskirts of the same city, on a road leading to a fine farming section, had 90 percent of its lockers rented to farmers. A locker plant in a Washington city of about 4000 population had 70 percent of its 1150 lockers rented to farmers, but an increasing number of local professional and business men were becoming renters. The farmers were paying their bills with meats and produce to be frozen and stored in the lockers—a bank for barter. One locker plant in Salt Lake City—an example of a large city installation—was patronized mainly for the storage of game shot in Wyoming. According to reports, a 1000-locker plant has been located in the heart of Seattle's largest fresh marketing center. In many locations, locker patronage is not confined to families, but includes restaurants, clubs, hospitals, and similar institutions, and even the local butcher.

The manager of a Washington cooperative creamery, which owned and operated a large locker plant, estimated that there were 1400 lockers in the area, serving a population of about 16,000. Others familiar with the industry in Oregon and Washington estimated that 600 lockers to 8000 population was about the right proportion, and that 500 could be counted on for full-time rental. Reports from Iowa and Minnesota indicate that about one-fourth of the families become users. One authority familiar with the industry estimates that 50 percent of the families in a community are potential locker patrons. Any attempt to work out a formula would be dangerous—too much depends on the progressiveness and prosperity of the section as well as the kinds and quantities of products available for storage.

THE MODERN COMPLETE-SERVICE LOCKER PLANT

A modern, well-designed locker plant consists of five main parts: locker room, chill room, aging room, sharp-freezer, and processing and cutting room. Additional unrefrigerated space may be divided into lobby, office, machinery room and wash room. Butchering and meat-smoking rooms and a separate room for fruit and vegetable preparation are included in many of the latest plants.

Locker Room

The general layout of the plant is based on the locker room, as the capacity of the other facilities is gauged by the number of lockers to be served. The entrance to the locker room should be direct from the lobby without an insulated vestibule, as most of the patrons are women who prefer not to have to open more than one of the heavy cold-storage doors.

Provision should be made to prevent any possibility of the lights being turned out while a patron is in the locker room. Without lights,

the locker room is the coldest, darkest, most confusing place imaginable. Several reports were received during the survey of patrons becoming panic-stricken because the lights went off while they were at their lockers. Provision should be made also against the possibility of a patron's being locked in at closing time.

Lockers

Steel lockers without ventilation are now generally used. The most popular size is 15 to 17 inches high, 20 inches wide, and 30 inches long. They are placed in tiers 5 or 6 high, and usually the bottom one or two are of the pull-drawer type. The usual aisle between locker rows is 2½ to 3 feet.

Locker-Room Temperatures

Many of the older plants in the Northwest were operated at 10° to 15° F., the temperature at which cold-pack fruits were usually frozen and stored in the early days of the industry. The progressive manager of one of the oldest and most successful plants, however, stated that he had found these temperatures too high for many products, also that fluctuating temperatures were detrimental to the quality of the frozen products. He had reduced his locker-room temperature to zero, and endeavored to hold it within a 5° variation.

Unfortunately many locker-plant designers have followed the early western practice and provided for 10° to 15° F. holding temperatures. At these temperatures pork cannot be held safely for more than three or four months, as the fat has a tendency to become rancid, and many vegetables will not retain their original quality. Learning from the commercial quick-frozen-food industry, as well as by experience, the locker industry now generally accepts zero as a safe temperature for long-period storage of all the foods usually frozen, and it is recognized that a uniform temperature is essential to the preservation of quality.

Of the 26 plants now in operation or under construction in Tennessee, all except four of the early installations are operated at zero.

Chill Room

The chill room is held at a temperature of 32° to 38° F. Many of the products entering the plant are first stored in the chill room, and it should therefore open onto the loading platform. Meat is hung in the chill room from 12 to 18 hours to remove the animal heat before it is placed in the aging room. Pre-chilling obviates the necessity of putting large quantities of fresh, warm meat into the aging room and disturbing its uniform temperature. Some authorities say that the "steam" from the warm meat forms a slimy deposit on meat already chilled in the aging room.

The chill room also provides excellent conditions for the tem-

porary storage of fruits and vegetables which cannot be processed immediately.

Aging Room

The aging room is held at the same temperature as the chill room, 32° to 38° F. The quality of frozen meats depends to a large extent on the proper aging—and the aging room is an essential part of the locker plant. Taking into consideration local conditions, a definite relation between the size of the aging room and the number of lockers can usually be figured. Pork is generally aged from 2 to 4 days; beef, 1 to 4 weeks; and poultry, 12 to 24 hours. Some authorities estimate that there will be a daily turnover of meat amounting to 2½ to 3 pounds per locker. In some sections the ratio of pork to beef may be two or more to one, while in other localities the amounts may be equal or beef may predominate. One general rule specifies one-half square foot of floor space in the aging room for each locker.

Some authorities are advocating the storage of cured hams, bacon and lard in the aging room rather than in the lockers. A demand may develop for the storage of cut fresh meats or game for short periods. All such possibilities should be taken into consideration.

The chill and aging rooms may be separated by an ordinary wooden partition since they are held at the same temperature. An overhead monorail is usually provided, which extends from the chill room into the aging room.

Sharp-Freezer Room

In order to insure the quality advantages of a rapid freeze as economically as possible, it is suggested that the sharp-freezer be operated at a temperature of -20° to -25° F., and that forced circulation of air be provided. Many authorities are suggesting temperatures of -10° to 0° F. and not specifying air circulation. It is true that many freezing rooms are now operated at these latter temperatures; also that many of the older and a few of the more recent plants have no sharp-freezing facilities but freeze in the locker room itself—a practice which increases temperature fluctuations in the locker rooms and deposits additional frost on the refrigerating coils. The commercial quick-frozen food packers have demonstrated the principle of a rapid rate of freeze for practically all products, and the freezer-locker industry can profit by studying their methods.

As the products remain in the sharp-freezer a relatively short time, the space required, as compared with the number of lockers, is much less than in the aging room, for instance. The lower the temperature and the more rapid the freeze, the less space is needed to handle the same volume.

The sharp-freezer in most cases is refrigerated by pipe coils

or plates so arranged as to form a stack of shelves on which the products to be frozen are placed.

Processing or Cutting Room

This room is not refrigerated. It should be adjacent to the aging room and the sharp-freezer for convenience in handling the products. Here the meats are cut to the patron's order, wrapped, labeled, and otherwise prepared for freezing. Preparatory work and packing of other food also may be done in this room, although a separate room is preferable.

The equipment of the processing room generally consists of a wrapping table, cutting table, meat block, power saw, power meat grinder, small counter scale, paper racks, and the usual butcher's equipment of knives, saws, and cleavers. It should have a sink with hot and cold water. Fruit and vegetable preparatory equipment is provided according to the types of service performed.

COST OF FREEZER-LOCKER PLANTS

Plants differ greatly in type of construction, capacity, and equipment; and the costs of materials, labor, and land vary widely in different localities. Existing buildings may be remodeled or added to, or new, modern buildings may be erected. Various materials, from shavings to cork, are used for insulation and the extent of the services offered govern the amount and cost of the equipment required.

A 500-locker plant in the Northwest was simply a wood-and-stucco addition to a soft-drink bottling works. There was an aging room, but no sharp-freezer room, and the plant was operated at 6° to 10° F. The lockers were home-made, of native fir slats. The owner estimated that the building and lockers cost $1800.00 and the refrigerating equipment $2200.00 installed—a total of $4000.00, or slightly more than $7.00 per locker.

In Washington, a neat-appearing new building, insulated with shavings, and containing 1150 lockers, was reported as costing between $11,000.00 and $12,000.00; the locally built, fir-slat, shellacked lockers, $2,100.00; and the full automatic refrigerating equipment, operated by a 15-h.p. motor, $4,500.00 installed—a total cost per locker of about $16.00.

A northwestern manufacturer of refrigerating machinery, who had equipped a number of installations, estimated that a typical 500-locker plant would require a 10-h.p. motor for holding at 10° F., and that the equipment delivered and installed would cost $2,500.00; the wood-slat lockers, about $2.50 each; and the building, in the neighborhood of $2,200.00. With complete meat-cutting equipment, the total cost was expected to vary from $10.00 to $15.00 per locker.

A cost study of 6 Wisconsin plants, recently published by Marvin

A. Schaars, of the University of Wisconsin, gave an average cost per locker of $31.75. Mr. L. B. Mann, of the Farm Credit Administration, reports cost studies made by him of 10 plants in Minnesota, Iowa, and Illinois,[1] which showed an average of $32.33. One manufacturer of locker-plant material concludes that the capital investment can be set conservatively at $25.00 to $35.00 per locker. Others estimate cost at $35.00 to $40.00 per locker.

SOURCES OF INCOME AND SERVICE CHARGES

Locker rental, service and processing charges, and brokerage on purchases for patrons are the main sources of income. Other possible sources are side lines to locker operation, such as retailing commercial frozen foods, fresh meats, and groceries; providing commercial cold-storage facilities for various kinds of foods; and freezing and merchandising local products. In fact, the needs of the community and the ingenuity of the plant operator are the limiting income factors.

A properly located and efficiently operated locker plant should be able to count on about 90 percent occupancy. Some outstanding plants visited during the survey were not only fully rented but had waiting lists and were planning to increase their capacity.

Locker rentals varied considerably. In Oregon, 10-cu.-ft. lockers were renting at $10.00 per year; 8-cu.-ft., at $6.00 for the 3 lower lockers and $5.00 for the top. Around Walla Walla, Washington, lockers of various sizes rented at from $5.00 to $10.00 per year, and some 30-cu.-ft. lockers for $14.00. Near Seattle, 5-, 8-, and 10-cu.-ft. lockers were renting at $6.00, $7.50, and $9.00. A well-equipped plant in the same general locality rented 8-cu.-ft. lockers at $6.00 per year, $3.50 for six months, or $2.00 for three months; and 16-cu.-ft. lockers at double these prices. In Salt Lake City, "large" lockers, rated at 350 pounds of meat, rented for $10.00 per year and "small" ones, rated at 150 to 200 pounds, for 75 cents per month.

It is generally considered that standard 20″ x 17″ x 30″ lockers should rent for $10.00 per year or $1.25 per month, and the large lower drawers for $12.00 per year or $1.50 per month. Lockers were formerly rented either by the year or by the month, but operators are adopting the policy of renting only for a full year, payable in advance.

Many of the early plants which provided meat-cooling and aging rooms, charged 1 cent per pound for cutting to order, wrapping, and placing in the locker. One of the more progressive plants had started at 1 cent but found it was losing money on the service and increased the charge to 1½ cents. This plant offered meat-smoking and -curing facilities at 4 cents per pound.

[1] FCA Circular C-107.

The modern complete-service locker plant is more expensive to build and operate than the early northwestern limited-service plants which used the available timber supplies whenever possible, and it is generally considered that income from services must equal locker rentals to insure a profitable business. Studies of operating costs for these plants indicate that annual costs may run from $10.00 to $17.00 per locker.

The following schedule of complete-service locker-plant charges is based on information obtained from various sources:

Beef to 400 pounds	Picked up and slaughtered	$2.50
	Slaughtered only	1.50
	Cutting and wrapping (dressed weight)	2.00
Beef over 400 pounds	Picked up and slaughtered	2.50
	Slaughtered only	1.50
	Cutting and wrapping (dressed weight)	2.50
Hogs to 300 pounds	Picked up and slaughtered	1.50
	Slaughtered only	1.00
	(Hogs 25 cents extra for each additional 50 pounds)	
	Cutting and wrapping (dressed weight)	1.00
Calves to 250 pounds	Picked up and slaughtered	1.50
	Slaughtered only	.75
	Cutting and wrapping	1.00
Lambs	Picked up and slaughtered	1.50
	Slaughtered only	.75
	Cutting and wrapping	.75

Service charges usually are quoted on a poundage basis, as follows:

Meat-processing charges per pound	Cents
Chilling, cutting, wrapping, sharp-freezing, and storing	1 to .5
Wrapping and freezing	.5 to .75
Grinding meat and sausage	.5 to 1
Rendering lard	2.5 to 3
Curing meat	2 to 3
Smoking meat	1 to 2
Cooling meat not intended for locker	1
Minimum charge for cooling or freezing	25
Brokerage fee for buying meat	1 to 2

Poultry-processing charges per fowl		Cents
Geese	Dressing	12
	Drawing	5
	Chilling, wrapping, and freezing	5
Chickens	Dressing	4
	Drawing	4
	Chilling, wrapping, and freezing	2
Ducks	Dressing	10
	Drawing	4
	Chilling, wrapping, and freezing	3
Turkeys	Dressing	10
	Drawing	5
	Chilling, wrapping, and freezing	5

Fish-processing charges per pound	
Scaling, chilling, wrapping, and freezing	5
Wrapping, chilling, and freezing (already cleaned)	1.5
Freezing (already cleaned and wrapped)	1
Freezing fruits and vegetables (containers not included) per pound	1

SAVINGS

Estimates and tabulations have been published showing to the tenth of a cent per pound what the farmer can save on his annual meat consumption if he freezes and stores his meat in a locker plant. These estimates usually compare the farm value of the 800 to 1000 pounds of meat supposedly consumed on the average farm—plus the locker-plant service charges—with the cost of the same meat at local retail prices. The estimators show savings of 9½ to 10 cents per pound, and from this they work out an annual cash saving of $75.00 to $100.00 per locker, less $10.00 to $12.00 locker rental. One fault with most of these estimates is in assuming that the farmer normally pays retail prices for all the meat his family consumes, not taking into account the meat actually butchered, cured, and consumed on the farm. Only on the part he customarily buys at retail, and which is replaced with meat he produces, can such estimated savings be justified. Farmers, as well as townspeople, may save by buying meats wholesale—for instance, halves or quarters of beef, from the local wholesaler, packing plant, or other farmers.

Protection against spoilage of home-butchered meats because of weather conditions and lack of adequate refrigeration facilities, represents a substantial saving in many localities, especially in the southern states. Ability to butcher whenever an animal is in prime condition, without regard to prevailing weather, may effect an appreciable saving in feeding costs.

An interesting example of actual saving by a locker renter in the state of Washington was reported during the survey. A farmer who had been delivering his beef to a local packer and buying meat against this credit found when his harvest season was over that he owed the packer $125.00. The next year he froze his beef and stored it in a locker and went through the harvest season with a total cash outlay of $25.00 for cured meats — indicating a saving of $100.00, less the locker cost.

It is difficult to estimate cash savings by freezing and locker-storage of fruits and vegetables, especially for families that do canning and preserving. The addition of fresh fruits and vegetables to the winter diet, in which they would otherwise be lacking and not having to can and preserve over the hot stove during the hot, busy season are perhaps the most important advantages. While practically the same preparation labor is involved in preparation for freezing, the long cooking is avoided. Fruits may be frozen in bulk, with or without sugar, and made into preserves when needed or convenient.

SUMMARY AND CONCLUSIONS

DISTRIBUTION

Quick-frozen food is the food industry's solution of the problem of preserving food in a fresh state and delivering it to the consumer the year round, at a reasonable cost, packaged, and prepared ready for use. It is in direct competition with both canned and fresh-market food.

Cold-pack, or frozen-bulk-pack, fruits enable processors to locate near the large consuming centers and operate all through the year on fresh fruits.

Experiments in quick-freezing fish were made as early as 1860, using ice and salt as the freezing medium, but development of the quick-frozen-food industry was made possible by advances in the science of mechanical refrigeration in the latter part of the nineteenth century. Experimental operations were carried on in various parts of this country and in Europe, out of which emerged freezing methods which are now in commercial use.

The Northwest developed cold-pack fruit operations into an established industry, starting commercial operations in 1918. The prohibitive distance from the large fresh-marketing centers in the Northeast, made this method of preserving perishable fruit of vital interest to the Northwest; but in the East freezing surplus fruit was carried on as a side line to production for the fresh market. Until recent years the eastern pack was not considered the equal of the standardized, quality pack of the Northwest.

General Foods Corporation started experimental quick-freezing of fruits, vegetables, and other foods, in the East in the middle 1920's, and its subsidiary, Frosted Foods Sales Corporation, began commercial distribution of the Birds Eye line to the institutional and retail trades in 1930.

Distribution became the new industry's most serious problem. The established food-distributing channels were not equipped with the low-temperature transportation and storage facilities required by quick-frozen foods. The ice-cream industry alone had storage facilities which were at all suitable for the new product.

Institutional distribution increased slowly but steadily. Retail distribution was hampered by lack of low-temperature retail storage facilities and by the need for consumer education regarding the advantages of frozen food and its handling in the home. By develop-

ment of reasonably priced storage cabinets which were rented to the retailer, and by local advertising and other sales promotion methods of consumer education, Birds Eye established retail distribution in the larger cities. Other distributors entered the business, and distribution to the institutional and retail trades grew steadily until by 1940 it had become national in scope. January, 1940, saw the first national advertising.

The entrance of the ice-cream industry into frozen-food distribution with its delivery and refrigerating facilities, was an important factor in increasing distribution of Birds Eye and other brands of frozen food, especially in sections of the country where other low-temperature facilities were not available. The ice-cream cabinet became the retailer's temporary storage cabinet until sales volume warranted investment in a standard frozen-food cabinet.

The development of reasonably priced low-temperature storage cabinets, the use of the ice-cream industry's facilities, and the spread of freezer-locker plants in rural sections have contributed to the present national status of frozen-food distribution, although not always on a convenient and standard price basis.

The distribution of frozen foods is cutting across established sales channels and is developing a trend away from specialization and toward more general methods of distribution. The wholesale grocer, the fresh-produce, meat, fish, and poultry distributors, take up frozen food to protect their original lines, and, once the refrigerating facilities have been provided, are in a position to carry the complete line of frozen foods—fruits, vegetables, meat, poultry, fish, and other seafoods.

The increasing popularity of quick-frozen foods is due to the preservation of their harvest freshness, and the shifting of all kitchen work, except cooking and serving, from the kitchen to the factory—that is, to their quality and convenience.

Frozen-Food Production

Until more definite classifications and nomenclature are adopted and frozen-food packers make segregated reports to some central agency, accurate and informative estimates of the total production or of the production for the three main markets will be impossible.

The most reliable estimates obtainable place the total quick-frozen pack as follows: 1937—145,000,000 pounds; 1938—250,000,000 pounds; and 1939—350,000,000 pounds.

A total frozen-fruit pack of 140,000,000 pounds in 1937 seems to be a conservative estimate; divided approximately, 115,000,000 pounds bulk-frozen pack and 25,000,000 pounds quick-frozen-carton pack. The quick-frozen vegetable pack in the same year is estimated at 70,000,000 pounds, which, according to informed sources, had increased to approximately 250,000,000 pounds in 1939.

Markets

The packer of frozen fruits and vegetables has three general markets for his products: the processors' market, as raw material for processing into other food forms; the institutional trade; and the retail trade.

The processors' market is the most important frozen-fruit market from a quantity standpoint, but the bulk of the production is taken by comparatively few buyers, who purchase in large quantities and whose consumption varies with the demand for their product. Prices are established with a narrow margin of profit, and except in the pie industry, no great national expansion can be expected in this market. Approximately 2/3 of the increase from 1935 to 1937 in bulk frozen fruits can be traced to the types of pack used by the pie baker.

The prospective institutional and retail markets are the present consumption of fresh, canned and other processed foods. The ultimate extent of the diversion to quick-frozen foods in this market is dependent on too many factors to permit any rational predictions.

Saturation of the institutional market has not yet been reached, and the status of the retail market is best illustrated by the fact that out of more than 600,000 retail food outlets in the United States, only 12,700 were counted as established retailers with standard storage cabinets at the end of 1939.

There has been no serious carry-over of high-quality quick-frozen products to date.

Sales Policies

The northwestern fruit packers have consistently distributed to the eastern trade through brokers located in the consuming centers. The eastern packers, located nearer the markets, sold a large part of their pack direct to the processor. Many eastern food processors put up their own packs. The eastern pack has improved in quality and now generally follows established distribution channels.

The greater part of the barrel pack of fruits is sold in advance of packing. As a result, if there is any substantial carry-over it is usually in the hands of the processors instead of the packers.

The distribution of quick-frozen foods, in general, follows established channels—from packer to broker, to wholesaler, to institutional or to retail trade—although many of the largest distributors deal directly with the packer and sell direct to wholesalers and retailers.

Birds Eye established exclusive retail distribution by owning the cabinets, which they rented to the retailers. Other distributors establish exclusive sales arrangements with the retailer by supplying a complete line of high-grade products. Eventually these cabinets

will be open to all brands, as are the grocery-store shelves. Until that time arrives, the small packer of a few items is at a disadvantage in the retail market.

Many packers are reaching the institutional and retail trades by packing private brands. While private-brand packing usually involves large orders and small sales expense, it does not establish the packer or his brand name in the industry, and he may be left without a market should his buyer go elsewhere for his supplies.

Packers located in the same general area sometimes consolidate their sales in the hands of a single agency, which gives the group a more important position in the industry than any one of them would have operating independently.

Retail Cabinets

Efficient retail cabinets may now be purchased from reliable manufacturers at reasonable prices and on extended terms of payment.

The relative merits of display and "blind" cabinets has been a live topic of discussion. The two largest distributors, accounting for approximately three-fourths of the total sales volume, built up their sales with non-display cabinets.

Estimated costs of operation vary widely, but $4.00 per month seems to be a fair average.

Cabinet insurance is now available to protect against loss of stock through power failure.

Dry-ice retail cabinets have been developed and are attracting attention. Comparative tests indicate that dry ice at slightly less than 2 cents per pound can compete with the usual electric power rates.

Long-distance, large-volume transportation facilities at the accepted zero-degree holding temperature for frozen foods, are not now available. With the most carefully controlled ice and salt mixtures, it is apparently impossible to maintain refrigerated car temperatures lower than 8° to 10° F. Dry ice with its possibilities of controlled low temperatures has made little headway in railway transportation.

Prices of cold-pack fruits for the processors' market, particularly for preserves and pies, are to a large extent controlled by the demand for the processed food. Prices of quick-frozen food for the institutional and retail trades should be practically uniform throughout the year, as are prices for canned goods.

The distribution of properly prepared and packaged quick-frozen products, transported and stored at 0° F., does not involve the losses incidental to the distribution of fresh fruits and vegetables.

PRODUCTION FOR FREEZING

In establishing freezing operations in any given locality several factors must be taken into consideration: a reliable supply of suitable products; the possible length of the packing season; and whether the growers will be content with a return which will enable the packer to compete with other packing areas.

In selecting varieties of fruits and vegetables for freezing, quality is of first importance. Quality requirements for freezing are more stringent than for canning. Only the finest-quality fruits and vegetables, harvested at their optimum maturity, should be frozen. Nothing in the freezing process will improve or equalize the quality of the products frozen.

All varieties of fruits and vegetables are not suitable for freezing, and a variety which is satisfactory when grown in one section may not prove equally desirable when grown under other climatic and soil conditions.

In general the home garden varieties which have the finest flavor, color and texture, are best for freezing—if yield and maturity characteristics are satisfactory. Varieties must be adaptable to the mass growing and harvesting methods practiced for the canning industry.

Tests indicate that the Tennessee Blakemore is at least the equal of any other strawberry now used by the freezing industry, particularly for the preserve trade.

The domination of the frozen-pack strawberry market by the northwestern Marshall was apparently due more to excellent packing methods and good salesmanship than to the characteristics of the variety.

The various production areas are inclined to believe their products superior to products grown elsewhere. There are no impartial arbiters of these opinions whose conclusions can be quoted. Local partiality to home varieties and types of products must be taken into consideration.

The leading production areas for frozen fruits are: Oregon, Washington, southern Louisiana, central Florida, the Chesapeake Bay region, Michigan, and New York.

Frozen-vegetable production areas are: The Pacific Coast, southern New Jersey, western New York, and southern Maine. Freezing operations are increasing in other vegetable-growing areas.

Practically all of the frozen blueberries used by the pie trade are imported.

The early-producing states can materially lengthen packing seasons for freezing, over present fresh-production periods. When

products are grown for freezing, there is no incentive for early production to reach high-priced early markets.

The production of frozen foods has not reached sufficient volume in comparison with the total food consumption, to show marked changes in production in the various agricultural areas, but there are indications of probable shifts.

Since the quick-frozen-food processor has no special interest in early crops or in proximity to his market—except as to availability of low-temperature transportation and competitive rates—he can locate his packing operations wherever the best products are most efficiently produced. When this is taken into consideration, together with the fact that quick-frozen fruits and vegetables, which are essentially fresh products and in direct competition with fresh produce, will be sold at uniform prices the year round, the conclusion seems inevitable that early or out-of-season products will lose much of their price advantage.

Processors and growers have worked out various methods of paying the grower in accordance with the quality of the product and its actual value to the processors. Processors sometimes refuse to contract with growers who refuse to follow proper fertilization and growing methods to produce quality products.

PROCESSING OPERATIONS

Preparation and processing operations for freezing closely parallel canning operations, up to the point where the product enters the freezer instead of the cooker. Quality control during all operations is even more important than for canned products, in order to retain the essential "fresh" characteristics of the frozen fruits and vegetables.

The packer's responsibility starts with variety selection, soil suitability, fertilizing schedules—all the factors which affect the production of a good product for freezing.

Prompt handling from the field to the freezer is necessary to retain color, vitamin content, and flavor and to prevent bacteria growth and quality deterioration. The vitamin C content of a frozen food is becoming recognized as an index to its quality, and is easily lowered by careless handling through plant operations.

Blanching vegetables before freezing is perhaps the most important as well as the most exacting of the processing operations. Blanching time and temperature must be kept to a minimum to conserve Vitamin C and other fresh characteristics, but must be sufficient to inactivate ferments and enzymes, or the product will lose color and flavor during storage. Authorities are not yet in agreement as to the best combination of time and temperature, and no specific rules can be given.

Frozen products are not sterilized by the processing operations, and sanitation in the packing plant is of the utmost importance. One authority states that the bacteria count of frozen vegetables should not be much above that of Grade A milk.

There are no Federal standards for grading frozen fruits and vegetables. Preliminary grades for frozen peas and lima beans have recently been issued and others are being prepared. The tentative grades require compliance with the Federal Food, Drug, and Cosmetic Act.

The many types of freezing equipment now being used by the frozen-food industry vary widely in length of freezing time required, but all are classed as "quick."

The continuous freezer, in various forms, is being used more widely on the West Coast than in the East, although its use is increasing here. The greater part of the national production is frozen in "batch" loading freezers.

For the bulk-pack of frozen fruits for processors, the 50-gallon wooden barrel and the 30-pound tins are most widely used.

Quick-frozen foods are generally packed in folding paperboard cartons with moisture-vaporproof inner liner or bag and a protective overwrap.

The principal problem in packaging frozen foods is protection against dehydration during long storage periods in the exceedingly dry air of the usual cold-storage warehouse. Mechanical and sanitary protection must be provided and the package made attractive and convenient from a sales standpoint.

At present the most widely used protective liners and bags are of moisture-vaporproof cellulose material.

The rectangular carton packs closely and is economical of space in low-temperature storage, in the retail cabinet, the freezer-locker and the home refrigerator.

The quick-frozen food industry has not standardized sizes, shapes, materials, or construction of containers to a point where mass production methods can be employed to an extent which will lower costs to a minimum, or to the extent containers have been standardized by the canning industry.

Processing frozen foods is not yet on a minimum cost basis. According to personal observation and informed opinion in the industry, the over-all cost of quick-freezing should be little if any higher than for canning goods of a similar quality. The higher cost of storage and transportation is the only apparent reason for higher prices to consumers, when processing and distribution are standardized and the industry is on a mass-production basis.

Storage rates for frozen foods are higher than for canned goods, but not much higher per month than cooler-storage for fresh fruits and vegetables.

Transportation rates are not consistent for various parts of the country and are complicated by car sizes and icing charges.

Fresh-produce marketing organizations are planning ways and means to meet frozen-food competition. Cleaned, graded, and packaged fresh fruits and vegetables are one method which is being tried.

Canners recognize frozen-food competition and are intensifying efforts to improve canned products. Many of them are establishing quick-freezing operations in their canning plants.

QUICK-FROZEN POULTRY

In 1937 Tennessee produced over 15,000,000 chickens, of which the producers sold about 47 percent, bringing in a cash income of over $4,000,000.

The distribution of quick-frozen, full-drawn, ready-to-cook poultry is increasing rapidly and promises to compete with other marketing methods.

Quick-frozen poultry began attracting attention in 1936, and consumer acceptance was so favorable that by 1938 many large packers in the heavy poultry-producing states entered the business.

To any retailer with a low-temperature storage cabinet, ready-to-cook poultry is just another neat, sanitary, packaged product.

The consumer likes quick-frozen poultry for its uniformly high quality and because the kitchen preparatory work has been done in the factory.

FREEZER-LOCKER PLANTS

The first freezer-locker plants in the Pacific Northwest started by freezing and storing game and domestic meats, and as the frozen fruit and vegetable industries developed, fruits and vegetables were added to the locker contents.

Spreading to the heavy cattle-producing sections of the Midwest, here again preservation of domestic meats was the original demand and fruit and vegetable storage a later development.

Above-zero temperatures in the locker rooms, improperly blanched vegetables, and the use of packaging materials which did not protect from dehydration were responsible for much of the deteriorated and spoiled food encountered in the early days of locker operation. When the practices of the frozen-food industry are followed, freezer-locker products, which are in every way equal to commercial frozen foods, can be frozen and stored for a year or more.

Since 1937, freezer-lockers have not only spread over the entire country, but they are increasing their usefulness to the community by adding services and facilities.

Two trends are apparent: one, toward the small 50- to 150-locker plants operated by grocery stores, offering a minimum of service and probably with a butcher, the only trained worker required, in charge of operations; the other, toward larger independent complete-service locker plants which operate cold-storage and other side-line facilities. The only limits to the operations of these latter plants are the ingenuity and ability of the operators to provide services and the capacity of the community to make use of the services and facilities provided.

Of most interest to the frozen-food industry is the increasing distribution of commercial frozen food by freezer-locker plants, and their tendency to become frozen-food packing plants. Many of them start by freezing the small local surplus crops of their renters; others are built with frozen-food distribution and production as main objectives.

According to conservative estimates, the approximately 3,500 locker plants in operation in the country in 1940 will freeze and store about the same volume of frozen foods as the estimated commercial quick-frozen food pack for 1939—that is, 350,000,000 pounds. Frozen meats make up the bulk of the locker-plant volume, although they are a minor item in the commercial pack, in which vegetables predominate.

A locker plant in the community should broaden the local market for the farmer's meat, poultry, fruits, and vegetables, since the town locker renter can buy fresh products from the farmer in season and store them for future use. The locker plant may help to stabilize the market for farm products by providing storage at the peak of production, when as a rule prices are lowest, especially if cold-storage facilities have been made a part of the plant layout.

In some sections the locker plant is carrying on small quick-freezing operations, freezing local products for sale locally or in neighboring markets. Success in these operations may lead to the enlargement of operations and extension of markets, possibly to the establishment of major packing operations in the area.

APPENDIX

PREPARATION OF FOODS FOR FREEZER-LOCKERS

Frozen fruits and vegetables that are comparable to the best commercial frozen products have been prepared and packed in the home and stored in freezer-locker plants. For best results care must be taken in the selection and the preparation, as well as in the freezing and storage in the locker plant. Authorities differ and instructions vary so widely that it seems advisable to suggest methods which have proved successful in commercial freezing so far as they can be adapted to available home equipment.

Practically all of our fruits and many of our garden vegetables have been successfully frozen. In general, vegetables having a high starch content, such as potatoes and too-far-ripened peas and beans, are not frozen. The same is true of those having a high water content, or those that are to be served raw for salad or other purposes where crispness is desirable, such as tomatoes, lettuce, celery, cucumbers, onions, and radishes.

Products should be selected at the best stage of maturity for serving or for cooking; that is, when flavor and appearance are at their best. Freezing will not improve a poor product. Locker space usually is limited, and it is poor economy to freeze products of doubtful quality.

Fruits and vegetables for freezing should be sorted and washed and all non-edible parts removed, as is done for canning or the table. They should be made ready to serve or cook without further handling. Cauliflower heads, broccoli, and other large items, should be divided into as small pieces as are suitable for serving. The small pieces blanch and freeze more quickly than larger pieces and pack more easily into containers.

If delays at any stage of preparation are unavoidable, the product should be kept as cool as possible short of freezing. This is especially important in the case of vegetables after they are blanched. The moist and broken surfaces offer ideal conditions for the growth of bacteria, and vitamin losses increase rapidly. Peas and beans retain freshness better when left in the pod. All vegetables should be kept crisp and unwilted.

If equipment for washing, blanching, and packing is installed in the locker plant it simplifies the preparation. Berries and such vegetables as peas, beans, and corn can be frozen before packaging.

The product can be spread out on trays in the sharp-freezer room, and an electric fan used to circulate the cold air. This method is followed by many commercial packers to insure a quick, uniform freeze of the individual pieces. Asparagus, spinach, and similar products, after freezing, are difficult to pack without breaking badly.

While the variety lists, pages 69-70, may be taken as a guide, these varieties are not the only ones suited to home freezing and are not necessarily the best. Many of the varieties were selected because they were the best available for commercial operations, combining good freezing qualities with high productivity and other characteristics not so important for home use. For instance, the commercial packers prefer bush varieties of peas and lima beans which mature uniformly and can be harvested, vined, and shelled by machinery. For home use, where small quantities are gathered and prepared by hand, pole beans and tall peas, which mature unevenly, may produce a superior frozen product. It is advisable to freeze and test small quantities of any untried variety before making large packs.

PREPARATION OF FRUITS

Fruits for freezing divide into two general classes: (1) the small fruits which can be cleaned and prepared whole without excessive injury to the skin and leakage of juice, and which do not oxidize, or darken, easily—such as strawberries, raspberries, blueberries, gooseberries, currants, cranberries, blackberries, dewberries, loganberries, youngberries, and boysenberries; and (2) the fruits which should be pitted or peeled, and which oxidize quickly when the cut or peeled surfaces are exposed to the air—such as cherries, peaches, and apples.

Three methods are used in packing fruit for freezer-locker storage: (1) dry pack (without sugar); (2) sugar pack; and (3) sugar-sirup pack. The method to be used should be decided upon according to the class of fruit to be preserved, the use to which it will be put, and the preference and convenience of the packer.

Dry Pack

All of the first class may be packed dry without sugar. The dry pack usually is preferred for making into pies, and may be used when the fruit is being frozen for later processing into preserves, jelly, or juice. The fruit should be carefully sorted, cleaned and, if necessary, washed. It should then be well drained to remove excess water and to prevent freezing together into a solid mass.

Sugar Pack

All of the first class, and also cherries, may be packed by the sugar-pack method. The fruit may be packed whole, sliced, chopped,

or crushed. One pound of sugar to 3 or 4 pounds of fruit should be used, according to taste and the acidity of the fruit. The sugar and fruit should be well mixed, so that the fruit is thoroughly coated by the dissolved sugar and juice when placed in the sharp freezer. All of the sugar should be dissolved before freezing starts.

Fruits for all uses may be packed by this method. The sugar pack is especially desirable, however, when the fruit is intended for dessert purposes. The sugar penetrates the fruit more evenly and the flavor usually is considered better than if the sugar is added when the frozen fruit is served. Commercial packers use the sugar pack for strawberries, packing them whole for preserves, whole or sliced for ice-cream manufacturers, and sliced for home consumption. Notes should be made of quantities of fruits and sugar, so that correct amounts of sugar can be added when the frozen fruit is made into preserves or jelly.

Sugar-Sirup Pack

All fruits may be packed in sirup. This is the most practicable method for home-preparation of peaches to prevent oxidation and loss of the fresh coloring. It is not as desirable as the dry and sugar packs for pies, preserves, and jellies, because of the additional water that must be cooked out. The sirup helps to prevent dehydration and protects the product to some extent from fluctuating locker-room temperatures.

The fruit may be packed whole, sliced, chopped, or crushed, and then covered with 40 to 60 percent sirup (3¼ to 7 cups of sugar to 1 quart of water), according to taste and the acidity of the fruit. The sugar may be dissolved in hot water, but the sirup must be cooled before being added to the fruit.

Additional Fruit-Packing Directions

Apples, peeled and sliced for pies, may be protected from browning by being dropped into a brine made of 4 teaspoonfuls of salt to 1 quart of water. They are then removed from the brine, drained, and packed in sirup. Another method is to scald the drained slices in boiling water or steam for 1½ minutes, cool quickly by dipping into cold water, drain, mix thoroughly 1 pound of sugar with 4 pounds of apples, and pack in container.

Cantaloup and other melons have been frozen sliced, but usually are diced or cut into balls for fruit cocktails or salads. They may be frozen dry, with waxed paper between layers to prevent freezing together, or in sirup.

Cherries of sour varieties should be stemmed and pitted. Sweet cherries should be stemmed but need not be pitted. Cherries darken

if not well covered with sirup or sugar. Firm-fleshed varieties, such as Montmorency, are most desirable.

Cranberries are packed whole, either dry or in sirup.

Figs are packed whole, not peeled, usually in sirup.

Fruit juices may be frozen with or without sugar.

Peaches for the freezer-locker, in order to avoid browning, must be handled even more quickly than for canning, since the cooking restores or neutralizes the color to some extent. They should be peeled as for canning by being dipped quickly into boiling water and then into cold. They are left in cold water, after the peel is removed, until they can be sliced, packed into containers, and covered with sirup.

Prunes and plums may be frozen whole, but usually are pitted and halved or sliced, the sugar or sugar-sirup pack being used.

Rhubarb is trimmed, not peeled, cut into 1-inch pieces, and packed dry or in sirup.

PREPARATION OF VEGETABLES

Vegetables should be carefully washed, sorted and trimmed ready for packing, before they are blanched. In home preparation they are blanched by dipping into boiling water. A wire basket or cheesecloth bag may be used. At least one gallon of boiling water should be allowed for each pound of vegetables. Two gallons are recommended for spinach and other leafy vegetables which wilt quickly and tend to cling together in a solid mass. The object is to raise the temperature of every part of each individual piece to the boiling point, so that no part will be left untreated to start changes that will affect the whole product. For instance, corn on the cob must be left in the boiling water until the center of the cob has reached the required temperature; otherwise the corn will acquire a disagreeable cob flavor. If scalding continues too long it will result in loss of vitamins and quality. Special attention, therefore, should be given to this operation.

Following are blanching times for various vegetables[1]:

	Minutes		Minutes
Asparagus, small stalks	3½	Cauliflower, small pieces	3
large stalks	4½	medium pieces	4
Lima beans, small	1	large pieces	5
medium	1½	Peas	1
large	2	Spinach	2½
Snap beans	2	Corn on cob, small ears	6
Broccoli, small pieces	3	medium ears	8
medium pieces	4	large ears	10
large pieces	5	Cut corn	1½

[1]Donald K. Tressler, N. Y. State Agr. Exp. Sta., Farm Research, Oct. 1938.

After blanching, the vegetables must be cooled as quickly and thoroughly as possible. This may be done by dipping into the coldest water available. Running water or ice water is excellent for the purpose. When cool, the vegetables should be drained well, packed into containers, and placed in the sharp freezer as quickly as possible—within 3 or 4 hours at the longest.

Additional Vegetable-Packing Directions

Brussels sprouts should have all loose outer leaves removed and be trimmed closely. Blanching time should be 3 to 5 minutes, according to size.

Carrots are diced and frozen by commercial packers for combining with peas. They may also be sliced, and should be blanched from 1 to 5 minutes, according to size of pieces. Small, tender carrots may be frozen whole.

Cut corn can be cut off the cob more easily and the kernels will stay whole better if blanched on the cob. Blanching time should be increased to 3 minutes.

Mushrooms should be handled quickly and carefully to prevent darkening. Blanching time for button-size is 2 minutes; for large size, 3 to 4 minutes. Large mushrooms usually are sliced.

Squash packed by commercial packers is cooked before it is packed for freezing.

Sweet peppers may be packed without blanching, but halves and slices pack more easily if blanched for 2 minutes.

If it is desired to freeze other vegetables than those mentioned, the general directions should be followed, and blanching times should be governed by the sizes of the parts to be blanched. It is advisable to freeze a small quantity and cook a test package before making large packs, if there is doubt as to the resulting product.

CONTAINERS[1]

Glass fruit jars, tin cans, heavily waxed paper cups, and miscellaneous containers which happen to be available, are all used in locker storage; as well as containers especially manufactured for locker use. If the containers are of moisture-vaporproof material and fitted with airtight covers, they will meet the moisture-vaporproof requirements. The use of non-moisture-vaporproof materials has been responsible for much of the dissatisfaction with freezer-locker products. Containers should, preferably be straight-sided or, still better,

[1]See Packaging, page 130 for general discussion.

wider at the top, to permit easy removal of the frozen contents. If the food is completely enclosed by, and sealed in, the moisture-vaporproof cellophane or other materials which have been developed especially for this purpose, any container may be used that will protect the contents and the wrapping against injury during handling and storage.

In general, containers should be used in sizes that will meet the family's requirements for serving or cooking at one time, and thus avoid partly used packages, which deteriorate and spoil rapidly if allowed to thaw out. Since it is a generally accepted rule that the more quickly the food freezes the better the quality, small containers, which permit quick freezing to the center of the package, are preferable. Fruits for processing into preserves may be packed in convenient batches for cooking.

When a liquid pack is used, or fruit juices are being frozen, at least 10 percent space should be allowed for expansion, or 1 inch for pint cans and 1½ inches for quart cans. If sufficient space is not allowed, the container will break or the contents spill over the top when freezing.

MEATS, POULTRY, GAME AND SEAFOODS

The general rules for freezing and storing fruits and vegetables apply equally to meats, poultry, game and seafoods—that is, select quality products, prepare ready for cooking, wrap in moisture-vaporproof material, freeze at point of maximum quality, and store at a constant temperature not higher than 0° F.

The conviction is spreading that beef and other meats for freezing, need not be aged nearly as long as for fresh use, since the freezing "tenderizes" to some extent by breaking down the tissues. This does not mean that tough, inferior meat will be transformed into a quality product; although there seems to be a general impression among locker patrons that their home grown supplies are improved by freezing.

Meats should be cut according to the requirements of the locker patron. Steaks, chops, cutlets, should be cut the desired thickness, wrapped, and stored flat to facilitate broiling without thawing. Hamburger, sausage, and other ground meats should be formed into patties, meat loafs, or any desired form ready for cooking. One locker operator spreads hamburger and sausage in shallow enameled trays and cuts into half-pound squares, which are then wrapped in moisture-vaporproof cellophane, two or more to the package, with waxed paper between the layers.

Poultry should be fully drawn and cleaned, ready for cooking. Fryers and stewing chickens should be cut up so they can be packed

in a small space and cooked without thawing if desired. They should be closely packed, or wrapped, in moisture-vaporproof materials, excluding all the air possible, before going into the sharp freezer, to prevent dehydration, or what is commonly called "freezer-burn". Glazing, which is used in many locker plants, is a more troublesome and less efficient method of protection and must be renewed frequently to be effective.

Ordinary tough butchers' paper may be used as an overall wrap to protect the moisture-vaporproof covering and to carry the rubber-stamped identification information.

Hams, bacon and all cured meats, if stored in the lockers, should be wrapped in moisture-vaporproof materials to prevent dehydration and the contamination of other products by the characteristic odors. Many plants are providing separate storage for cured meat products.

CARE OF FROZEN FOOD IN THE HOME

Unless frozen food can be kept frozen, it should be used promptly. *Once thawed, it should not be refrozen.* Vegetables should be partially cooked if they cannot be used soon after thawing. Twenty-four hours may be allowed after thawing, if they are kept in the food compartment of an efficient refrigerator. Products kept frozen in the freezing compartment begin to lose quality as their temperature is raised above 0° F., although remaining solidly frozen, but may be held a week or more without noticeable deterioration, depending on the temperature of the compartment.

All products should be allowed to thaw *in their moisture-vaporproof wrappers*, preferably in the food compartment if time permits; if not, at kitchen temperatures, under an electric fan, or, if the container is water-proof, by immersing in cold, running water.

COOKING AND SERVING

Fruits are considered best when served just before they are completely thawed out. Dry-pack or sugar-pack fruits may be put into pies or into the preserve kettle without thawing.

Vegetables are considered best when plunged into boiling water while frozen, but may be allowed to thaw first. Only enough water should be used to prevent burning, and the residue should be served with the vegetables.

Cooking times are shorter than for fresh vegetables by approximately one-half, starting from the time the thawed mass resumes boiling. Frozen vegetables, if overcooked, will lose their fresh flavor and color.

Meats, poultry, and fish may be cooked while frozen or allowed to thaw. Meat should as a rule be cooked immediately on defrosting as otherwise it will "leak", resulting in loss of moisture and flavor. It will require longer cooking than fresh, if cooked while frozen, but slightly less if defrosted. Steaks, chops, hamburger, etc., may be seared in a hot pan or broiler, then held at a lower heat until the hard center has thawed, and the cooking finished as usual. Care should be taken that the temperature is not lowered sufficiently to allow leakage, resulting in a "stewed", dry, product.

Chickens, turkeys, ducks, may be stuffed while frozen and roasted— in fact they can be stuffed before freezing—but this adds to the cooking time and a meat thermometer is helpful to insure reaching the proper temperature at the center of a large bird. Fryers and fish fillets cut ready for cooking, the pieces separated by waxed paper or other means, may be broiled, or rolled in flour and fried, with or without defrosting. When practicable, it is believed better results are obtained by cooking meats and poultry before defrosting, after the slightly different cooking technique has been mastered.

INDEX